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MACHINE DESIGN

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ENGINEERING

PRODUCTION

SALES

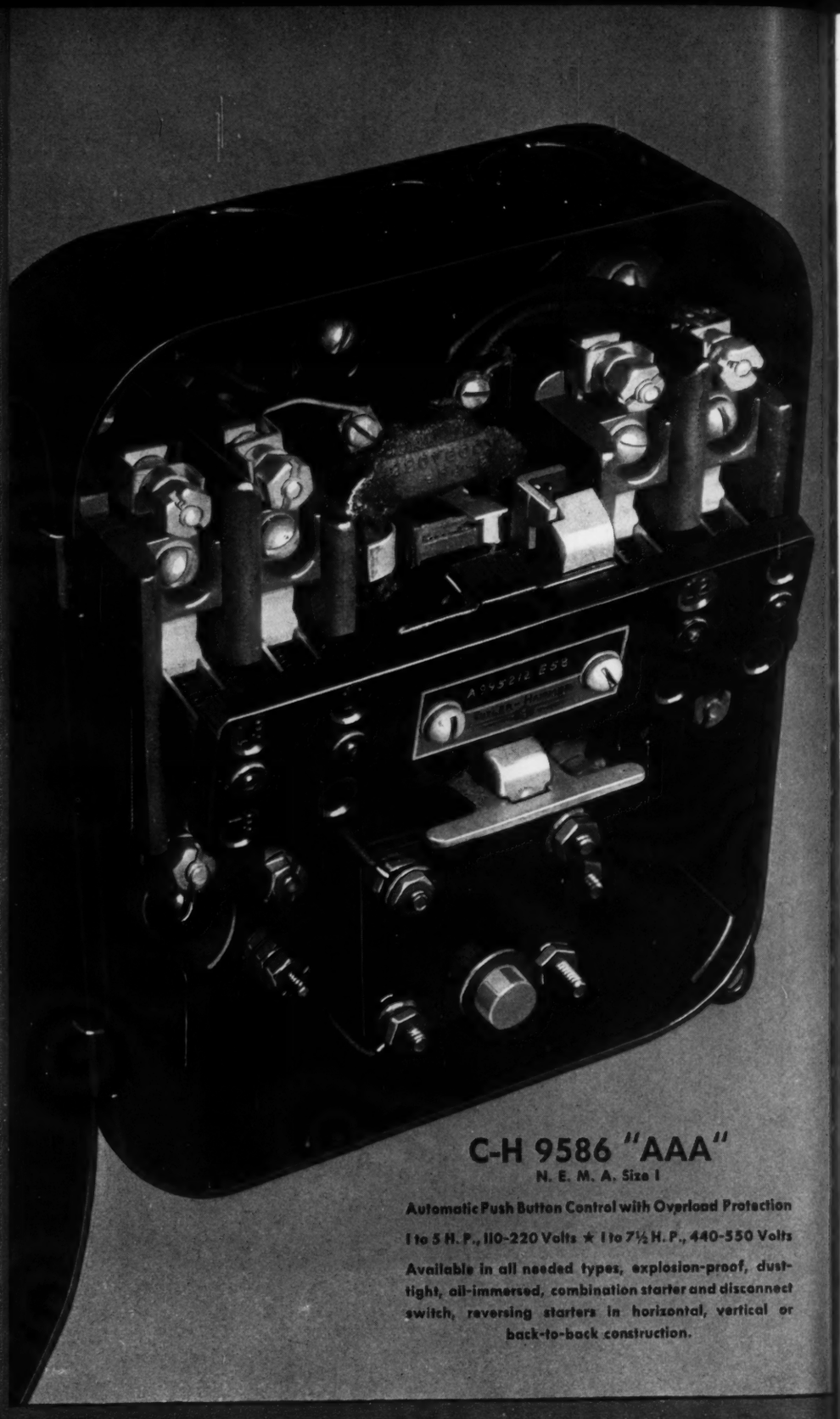
Parts . . . . Materials . . . . Methods . . . . Finishes

INSIDE

YOU FIND THE REASON

THROW open the door of a Cutler-Hammer 9586 "AAA" Motor Control and see with your own eyes the reason for its outstanding success . . . *why* it's wanted . . . specified . . . demanded by most buyers.

Its advanced engineering revolutionized small-motor control. The extent to which it has been copied proves this beyond any doubt. Its superior construction brought an entirely new standard of performance —*millions of operations*—a standard few competitive devices can approach under direct comparison. Its simplicity, its dependability, its ease of adjustment, its accuracy of overload protection . . . all the features that keen buyers seek . . . recommend the C-H 9586 "AAA" for *your* consideration. The more you investigate, scrutinize and compare, the more reason you will find for C-H 9586 "AAA" leadership in its field of service . . . and the more likely you, too, will refuse to accept any substitute for its performance. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1310 St. Paul Avenue, Milwaukee, Wisconsin.



C-H 9586 "AAA"
N. E. M. A. Size 1

Automatic Push Button Control with Overload Protection

1 to 5 H. P., 110-220 Volts ★ 1 to 7½ H. P., 440-550 Volts

Available in all needed types, explosion-proof, dust-tight, oil-immersed, combination starter and disconnect switch, reversing starters in horizontal, vertical or back-to-back construction.

CHECK THESE EXCLUSIVE FEATURES

1. Solid silver contacts—made from bimetal billets of silver and bronze rolled to size. Not merely silver plated or spot welded silver contacts—but solid hard silver, full-area contacts that assure much longer life.

2. Both the armature lever and the movable contact bridge are easily removed without tools—without disturbing the contact springs or any other parts.

3. The stationary contacts may be replaced individually by removing only one screw.

4. The operating coil may be removed by merely bending up the clips. The 9586 "AAA" may be changed from one voltage to another in 2½ minutes.

5. The heater coil in the overload relay can be changed in less than 2 minutes to adjust for motor size. Only a screw driver or pliers is needed.

6. The entire panel of a "Triple A" can be removed for wiring by loosening only a single mounting screw.

7. Only genuine Thermoplax arc barriers such as used in heavy duty control are used in 9586 "AAA".

8. NEW MAGNETIC LATCH . . . Permits use of standard starter where subjected to severe shock, as on portable machines, etc. Feature pioneered by C-H now further improved. Operates on very low voltage. Long life. Foolproof.

CUTLER-HAMMER

Triple A MOTOR CONTROL

Built to the Standard of Millions of Operations

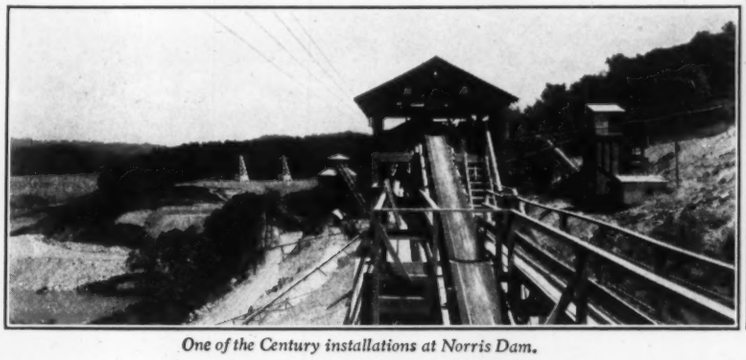
CENTURY SQUIRREL CAGE INDUCTION MOTORS

UP TO 600 *Horsepower*

ON particularly tough, dirty, wet jobs you will find Century Motors setting a record of continuously satisfactory performance! This statement stands on more than 30 years' proof! It is your safeguard in the selection of motors for driving your product or plant equipment — no matter what it is — no matter what severe demands are imposed upon it!

Here's more proof that Century can do a job for you:

T·V·A· *and* CENTURY



One of the Century installations at Norris Dam.

For Materials-handling Equipment Century Motors are engaged in the dirtiest, toughest kind of service — many of them exposed to the elements — driving Rock Crushers, Gravel and Rock Screens, Conveyors and similar equipment . . .

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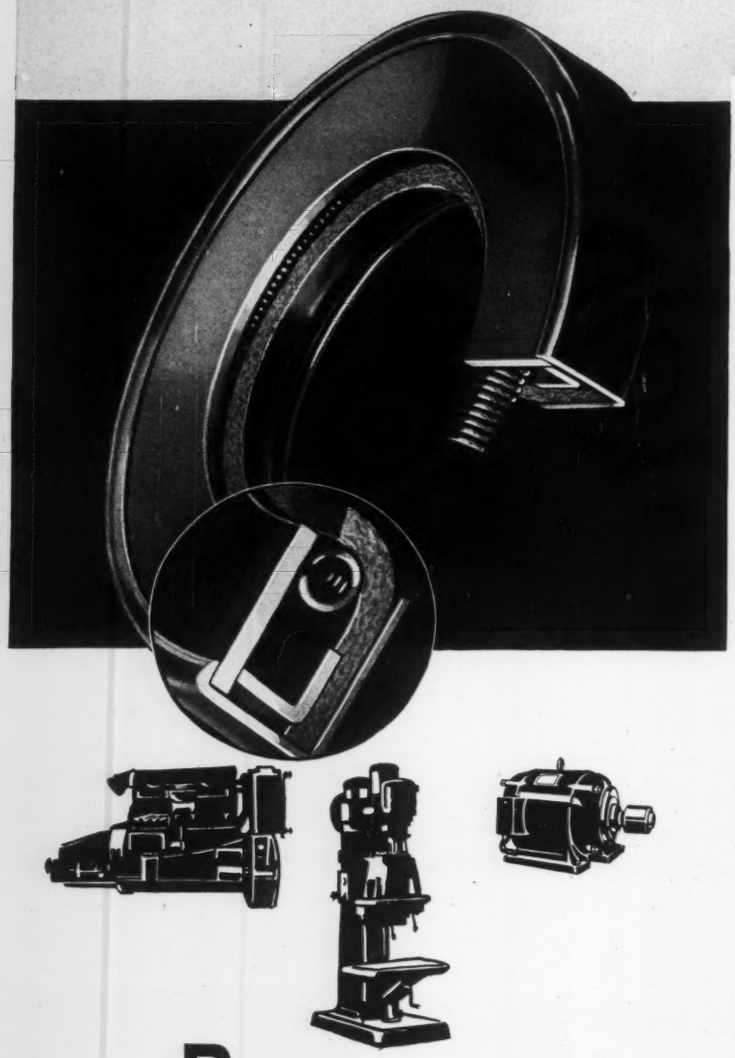
KEEP YOUR EQUIPMENT *Sold*



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PATENTED

● The bearings in the machinery you build and sell have more to do with the buyer's satisfaction than practically any other element. Keep those bearings in good condition and you keep your customer satisfied.

There are many ways to protect bearings but no device available today has the combination of structural and material advantages you secure in the Locked Spacer construction of the "Perfect" Oil Retainer. It seals the oil in the bearing and excludes all foreign matter. It is easier to install, takes less space and more punishment than other seals.

Standardize on the "Perfect" Oil Retainer as the cheapest means of maintaining good will and keeping your equipment sold.

●

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PARTS • MATERIALS • METHODS • FINISHES

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 7 DECEMBER, 1935 Number 12

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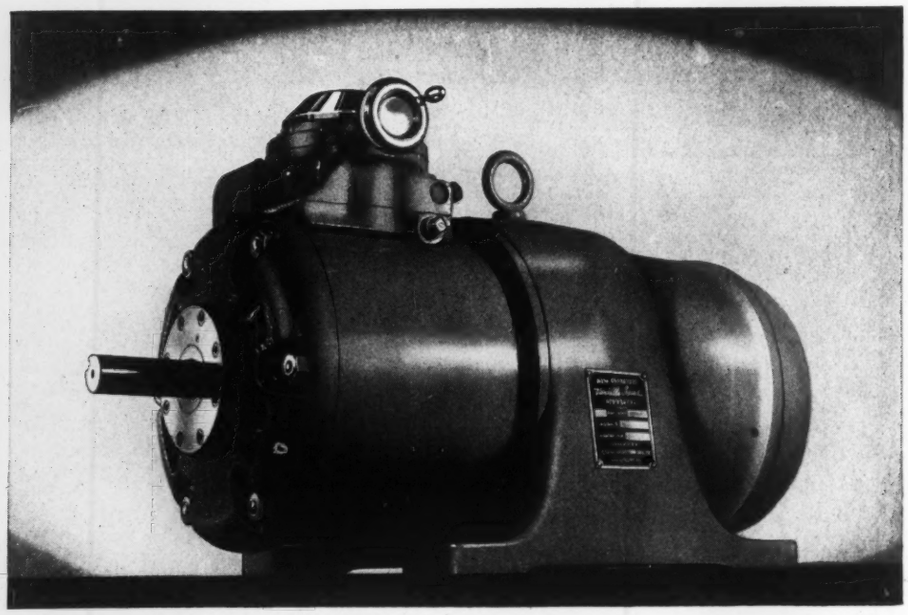
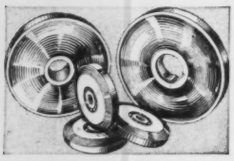


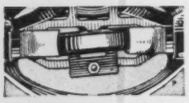
Thousands of Speeds
at the touch of a finger

Speed infinitely adjustable throughout entire range. Ratio, 6 to 1. Transmission and motor built as one compact, highly efficient unit.

Hardened steel rollers transmitting drive from constant speed input race to variable speed output race operate under torque - controlled contact pressure. Rollers inclined by operation of speed control roll themselves into required ratio position. Only finger touch required on control wheel.



RACES AND ROLLERS



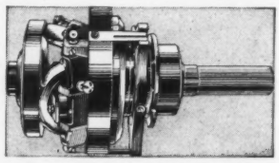
INCLINED ROLLER

Speeds may be pre-selected or adjusted while running.

With 1,750 r.p.m. motor, *any* speed from 600 to 3,600 r.p.m. immediately available. Built with 1,200 or 900 r.p.m. motors for correspondingly lower speeds.

Always starts from and stops in low-speed, high-torque position. . . . Avoids overloading motor.

Positive drive is assured under all conditions of loading, including rapid reversing or extreme overload.



RACE AND ROLLER ASSEMBLY

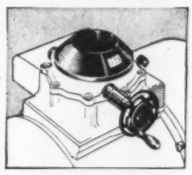
Unit is torque conscious. Automatic pressure device utilizes the imposed torque load to generate the required pressure between rollers and races. Pressure is always proportional to the input or output torque load—never exceeds requirements.

TORQUE FLANGE

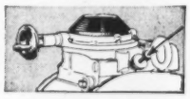
Revolving parts in positive rolling contact are inherently in balance, assuring exceptional quietness and freedom from vibration at all speeds.

No adjustments of any kind are ever required. New Departure Ball Bearings used throughout.

Outstanding ease of control . . Speed changes obtained instantly either by handwheel on unit or remote control to suit any type of installation. Full automatic cam-operated control for speed changes occuring in variously timed cycles.



SPEED CONTROL



TIME CONTROL

Time required for unit to shift up or down to any desired speed is readily adjustable. Minimum time, low to high or vice versa, three seconds.

Unit adapted to mounting in any position — vertical, horizontal, sidewall or ceiling.

Send for catalog PD, giving detailed description.

The New Departure Manufacturing Company, Bristol, Connecticut.

NEW DEPARTURE
Variable Speed
TRANSITORQ

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CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

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Better. . .because THEY'RE WELDED

● Modern stainless steel barrels are *better because they're welded!* Welding assures strong, seamless, leakproof containers which are easy to clean and afford no place for bacteria to develop. These inherent features of jointless design and fabrication by welding, together with the natural resistance of stainless steel to chemical attack make sure that nothing will effect the contents of the barrel.

Welding has made many good products better—stainless steel barrels, refrigerators, automobiles, radios, streamlined locomotives, metal furniture, and a thousand other things. You, too, may find it profitable to consider the advantages in both production and sales which can be gained for your product by jointless design-for-welding.

Linde engineers will gladly cooperate with you in the design or redesign of your products for welding. The benefit of their broad experience is available from Linde Sales Offices located in thirty principal cities throughout the country and at 30 East 42nd Street, New York, N. Y.

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Unit of Union Carbide and Carbon Corporation

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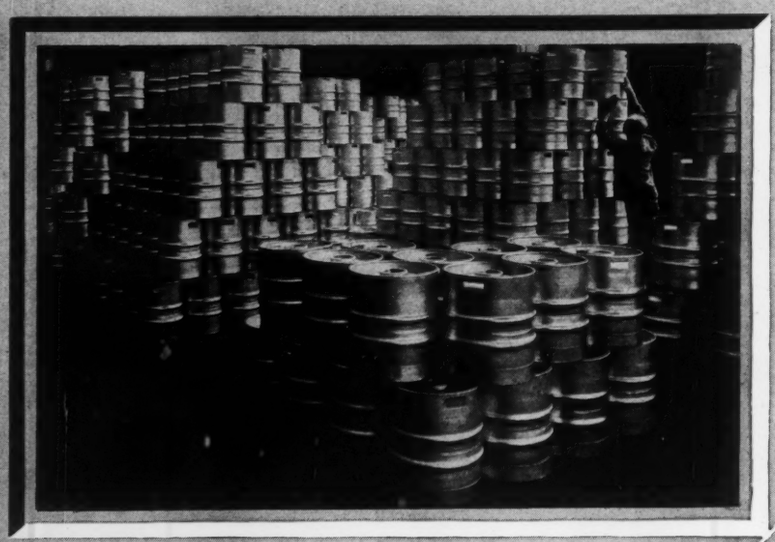
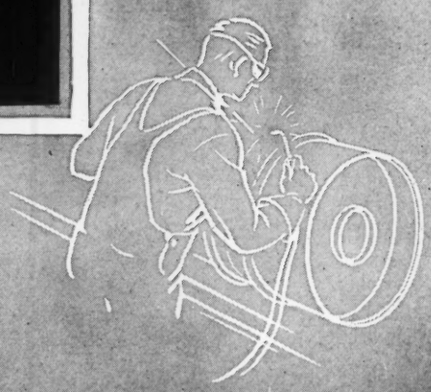
PREST-O-LITE DISSOLVED ACETYLENE
OXWELD WELDING AND CUTTING APPARATUS AND SUPPLIES



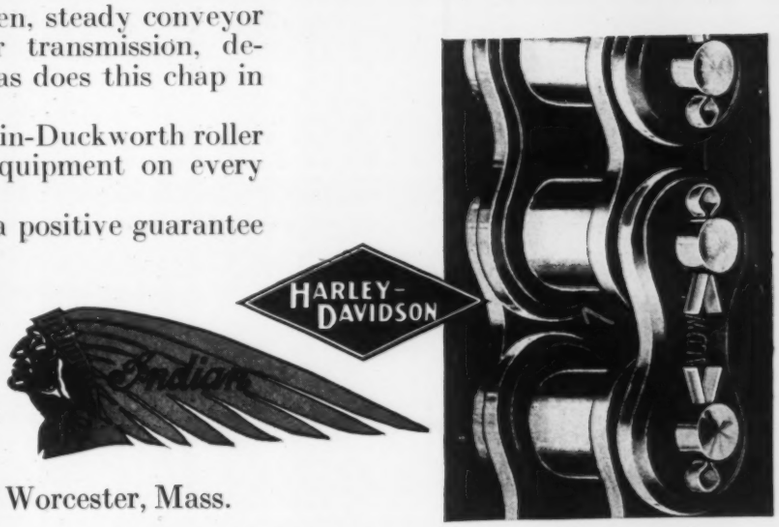


"Traffic" control in your plant—even, steady conveyor operation—smooth, efficient power transmission, depends on trustworthy roller chain; as does this chap in his highway traffic control job.

His machine is equipped with Baldwin-Duckworth roller chain—for many years standard equipment on every American made motorcycle.

Baldwin-Duckworth roller chain is a positive guarantee of reliable performance—accuracy—real economy. Send for complete catalog, showing all sizes of single and multiple chains, attachments, sprockets, and engineering data on power transmission and conveying. Baldwin-Duckworth Chain Corporation, Springfield, Mass.

Factories at Springfield, Mass. and Worcester, Mass.



BALDWIN—DUCKWORTH

Sinbad's Burden

. . . Yielding to the pleadings of the Old Man of the Sea, Sinbad lifted him onto his shoulders and carried him tenderly across the stream. To his amazement, the Old Man refused to alight. Instead, he entwined his legs so tightly around Sinbad's chest that he could not be shaken off. Day after day Sinbad's burden became more and more crushing. . . .

A MATERIAL, process or modus operandi will sometimes so firmly imbed itself in the construction of an implement, appliance, engine, machine, vehicle, or part, that discarding it in favor of something more modern is often difficult. Meantime, its continued use may become a serious burden to both production and sales departments. . . . For competition is ever ready to capitalize a rival's lack of progressiveness

Is the persistent retention of once modern steels threatening to leave your company behind in the face of the newer discoveries of metallurgists and steel-makers? Have you brought yourself up to date on the latest progress of Molybdenum — the alloy which not only improves ordinary carbon steel, but actually increases the effectiveness of other alloys?

Greater strength, toughness and shock resistance, less temper embrittlement, easier machinability and welding — these are some of the qualities "Moly" imparts to steel and iron. Yet so powerful is Moly, and so little is the quantity required, that it seldom adds to — and generally reduces — the ultimate cost . . . because it usually lowers the first cost in alloy content, means fewer rejects and effects other shop economies.

Investigate Moly. Moly has had more than a decade of countless laboratory, steel-furnace, foundry, forge and punishing service tests. We invite engineers, metallurgists, production and business executives to write for either or both of these interesting books: "Molybdenum in 1934" and "Molybdenum in Cast Iron — 1934 Supplement." Also ask us to mail you our periodical news-sheet, "The Moly Matrix." Be free, too, to enlist the aid of our Detroit experimental laboratory. Climax Molybdenum Company, 500 Fifth Avenue, New York.

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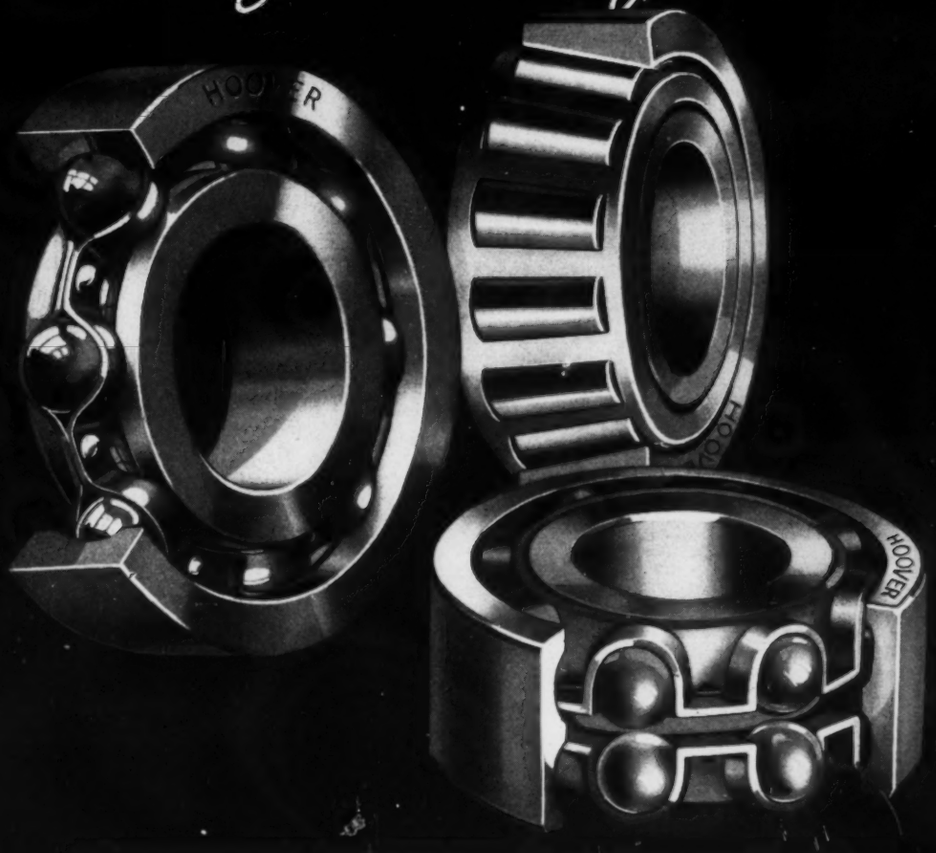
CLIMAX Mo-lyb-den-um

INDUSTRY'S MOST MODERN AND VERSATILE ALLOY

The ARISTOCRAT of Bearings



Hoover Bearings in a product are proof that the manufacturer has used the finest at his command.

HOOVER

STEEL BALL COMPANY

ANN ARBOR • • • MICHIGAN

Topics . . .

REFRESHING is the prediction by a prominent machine tool builder: "Next spring will see a substantial improvement in employment conditions throughout the country and a sharp decline in the number of people on relief." With that hopeful outlook, let's see what's happening.

Air conditioning for autos is coming. A five-passenger car has been touring the country, with successful results.

Have you read about the suspended monorail system for high speed passenger transportation that is being given consideration in New York? And did you know that Gar Wood, the noted boat builder, now has a company that will produce buses and coaches designed by W. B. Stout? The streamlined bodies are to be unit-built on a framework of welded steel tubing.

This streamlining bug is playing havoc with tradition. Even the automobile door handle has been branded as a road menace. A Baltimore physician says these dangerous projections are the cause of many disfiguring injuries and occasional deaths.

Glass bricks, now a reality, may be outside the machine designer's bailiwick but who knows what engineers may do with them yet? More practical from a mechanical standpoint is the new glass wool that is being employed for filtering and insulation.

Stratosphere flights are drawing attention to the higher altitudes. At Harvard Arthur E. Bent and Dr. Karl O. Lange have developed a robot which radios the condition of the upper sphere back to a ground station.

A new dictionary of letters and abbreviations, the language of engineers and scientists, will be undertaken by a committee of the American Standards association. Rapid coinage of new words and terms, and the adoption of foreign words and phrases in the various fields of engineering demands a new compilation of standard usage, the committee says.

Rolling of metals direct from the furnace is in the eye again. Bessemer tried it in 1846 so the idea is not new. More, no doubt, will be heard about this process as time goes on.

Father of the chromium plating process, Prof. Colin G. Fink of Columbia, now tells the world he has discovered how to coat steel with aluminum. Also announced recently in the finishing field is a new rustproofing process called Cromodizing.

Indications are that the Cunard White Star liner QUEEN MARY will go into service next spring. The entire hull and upper decks of the ship now are practically complete. Will she break the speed records of the NORMANDIE?

Diesel engine trains have brought the diesel into such prominence that other countries are showing more activity in diesel design. A dispatch from Copenhagen, Denmark, says that a "light" diesel engine has been developed there. The Danish company building it is believed to be one of the first in the world to manufacture the diesel type of engine.

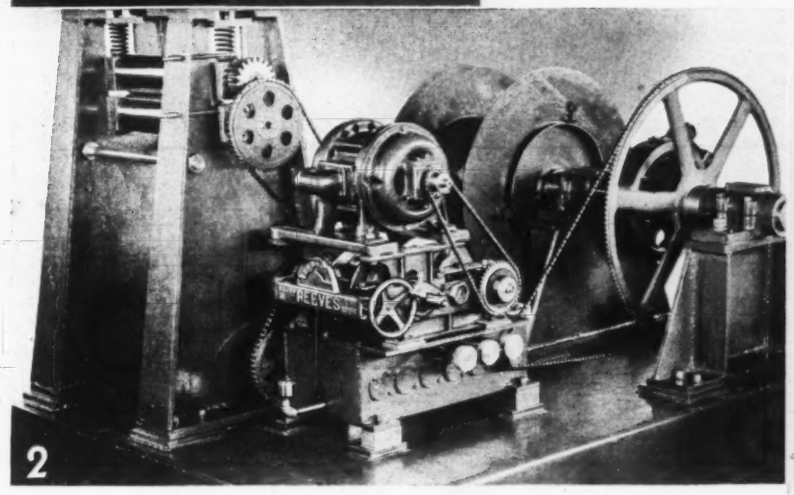
Many engineers will visit Cleveland next year to see the industrial exposition which is to have the romance of the iron and steel industry as its central theme. For three months this event will dramatize the various phases of activity in the Great Lakes area.

Now Col. L. P. Ayres, prominent statistician comes along with this statement: "For the first time in six years business activity has had a normal seasonal increase in volume this autumn."

That should be a fitting conclusion to any compilation of monthly topics.

Modern Speed Control PLUS a Complete Engineering Service

1



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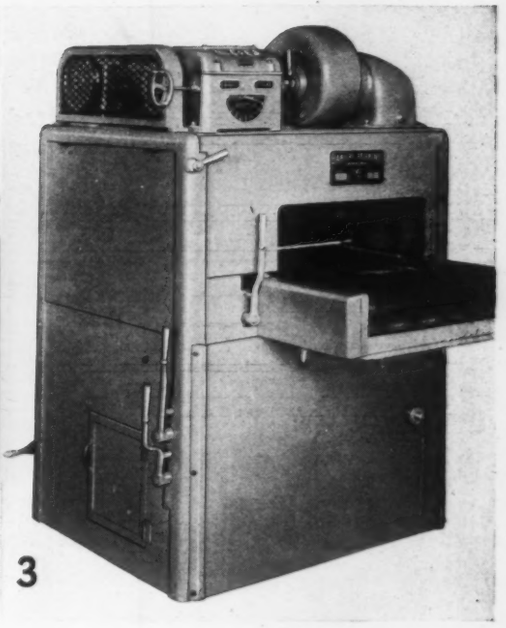

3

THE three applications of the REEVES Variable Speed Transmission pictured here didn't just "happen."

Each one was first carefully worked out in drawings and blue prints by a REEVES engineer—a speed control specialist—who carefully studied his customer's requirements and, from his own broad experience, knew how most successfully to apply the correct unit to meet a specific problem. Available space . . . speed ratios . . . h.p. available . . . driving connections . . . method of control (manual, electric remote, hydraulic, mechanical or electric automatic control) . . . all are matters calling for the exercise of careful and thorough engineering judgment.

Behind every REEVES installation—thousands of them on more than 1100 different *kinds* of machines—is *manpower*, in factory, laboratory and, of primary importance, in the field. Many of these men are veterans of 8, 10, 15 and more years of specialization in speed control engineering.

To insure a correct type of unit for every application, REEVES engineers have developed a wide range of sizes, designs and controls. From this complete line of equipment they select the proper unit for the individual requirement. Use this unequaled combination of facilities to guarantee the success of your own installations from the standpoint of complete speed adjustability.

1 CONTINUOUS TRAVELING CUT-OFF—REEVES Speed Control, provided as standard equipment, helps make possible the meeting of two very exacting requirements—high speed with extreme accuracy—in this Traveling Cut-off. Maintains exact length of board, regardless of thickness, at *all* different speeds. Maximum speeds up to 300 f. p. m. Accuracy to within $\frac{1}{16}$ inch.

2 WINDING REEL—for pulling metal strip through annealing furnace at any desired speeds ranging from .06 to 3.82 f. p. m. (630:1 ratio). REEVES Transmission provided as standard equipment to control Pull-Out Rolls which deliver stock to steel spool. A one h. p. REEVES horizontal open design, 6:1 speed ratio, is used, variable speed shaft being connected by roller chain drive to high speed shaft of a special change-gear box.

3 CHOCOLATE COATER—which gives a coating of any pre-determined thickness to many different sizes and shapes of chocolates. This flexibility of operation secured through REEVES Speed Control. Note compact mounting of enclosed REEVES Transmission on top of Coater and convenient extension of handwheel control.

REEVES
Variable Speed Transmissions

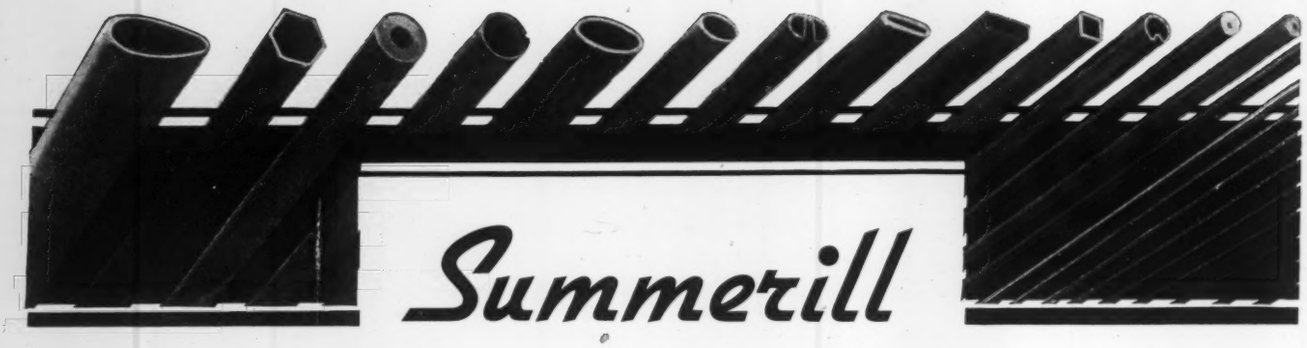
REEVES PULLEY COMPANY
Columbus, Indiana

Send information on applying speed control as standard equipment as contained in your new Speed Control Handbook H-35.

NAME .....

COMPANY .....

ADDRESS ..... (12-35)



Summerill Seamless Tubing

. . . a skillfully finished commodity with a boundless range of application

REFINEMENT of finish promotes the versatility of any product. This is primarily true of Seamless Tubing—for, in this commodity alone, its application to most needs is solely dependent upon its accuracy and uniformity of size, its superior physicals, smoothness of finish and its improved grain structure. To acquire and constantly maintain these standards means a strict adherence to specialization.

Summerill processing is Summerill's specialization. We do not make steel nor do we engage in making tubes. We concentrate our full efforts in the tube's finish. We might even add that the entire personnel of our plant is each an artisan whose aim is directed more toward the production of quality rather than quantity.

With a set-up as such, Summerill is especially intrigued by the intricacy and uniqueness of a tubing problem. Additionally helpful to our solving of the unusual is the wide latitude served by the many grades, sizes, shapes and weights processed.

To better acquaint the business executive, engineer and designer of the metal working industries with our product, we have carefully compiled—"Tubing by Summerill"—a combined catalog and data book, rich with valuable tubing information. A copy will gladly be presented upon receipt of your title and letterhead.

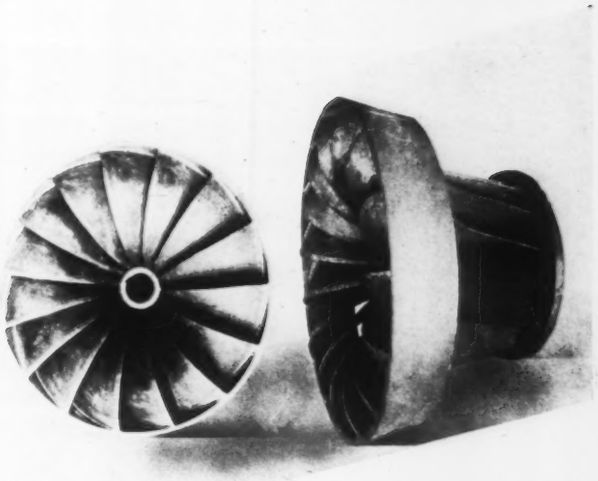
SUMMERILL TUBING COMPANY

SPECIALISTS IN TUBING SPECIALTIES

BRIDGEPORT, MONTG. CO., PENNSYLVANIA

MACHINE DESIGN

Weight, Machine Parasite, Cut with Low-Alloy Steels



By Allen F. Clark

Fig. 1—In transportation equipment lessened dead weight makes possible an increase in payload. Fig. 2—Lower weight in turbine runners, achieved through the use of high tensile steels, enables higher efficiency

IF A designer, checking installations of his machine, found that the operators casually hung a few spare gears on a moving part, stored surplus material on another, and laid several sashweights on the frame for good measure he would be incensed and alarmed at the senseless handicapping of efficiency through

useless dead weight. Such an addition of dead weight is ludicrous. Yet a great many designers are adding useless weight in not quite so apparent a form. And in these cases it is not ludicrous, but a tragic waste of operating efficiency.

Tradition Often Governs

This dead weight may be found in the parts and frames of a great many machines. Not in the parts where the weight is a necessary requisite of the design, but in those parts that are inordinately heavy because it is believed that no other material than that being used will give the required strength. As might be expected, railroad and other transportation equipment builders were the first to discover that there are available materials which will give them equivalent strength with less weight. In transportation equipment the higher the weight, the smaller the pay load. Other industries are now following the lead of the transportation industry because the pay load of other machines is increased efficiency, and that extra 3 per cent efficiency corresponds in general machinery to three more passengers on a street car.

The materials being employed to secure this lessening of weight, and, equally important, increased corrosion resistance, are the newer high tensile, low alloy steels. These high tensile steels fall within the gap formerly left between ordinary carbon structural steel and the more expensive alloy steels.

A large variety of alloys of varying quantity are employed in these steels, the most common of which are manganese, silicon, chromium, nickel, molybdenum, copper, phosphorus and vanadium. High physical values are obtained in most instances with relatively low carbon content. This condition is ideal for welding, as it eliminates almost entirely the objectionable air hardening experienced in welding steels of the higher carbon range. With the use or consideration of welding in one form or another for parts of practically all machines, weldability is an important attribute of any sheet steel.

Minimize Atmospheric Corrosion

As these steels, with their increased corrosion resistance, minimize the effect of atmospheric corrosion, lighter gages with greater strength and durability can be used to satisfy the necessity for light weight in all types of machinery. In a number of uses, the weight of a section can be safely lightened without changing the basic design. But in any use where deflection or sagging would be undesirable, this can be avoided by modification of the fundamental design of the fabricated sections so as to lighten the weight by taking advantage of the greater strength and corrosion resistance of the high strength steels. Due to the inability of any chemical, thermal or mechanical treatment to change the modulus of elasticity, intelligent redesign must take into account the necessity of maintaining the same moment of inertia in the redesigned section through the use of ribs, beads, corrugations and the like.

Yield points and tensile strengths are about one-third greater than for ordinary steels. The resistance to atmospheric corrosion is considerably greater in all

TABLE I

Rolled Plate and Weld Values of Low Alloy, High Tensile Steels

Cromansil Steel

Mill Report

C	Cr	Man.	Sil.	Y	Ult.	% El.
0.14	0.47	1.24	0.76	61,700	90,900	25
0.21	0.55	1.29	0.75	70,100	99,800	23

Manten Steel

C	Man.	Sil.
0.27	1.54	20.4

	Y	Ult.	% El.	Red.	Failure
As Rolled	58,340	94,000	8 In.—22	57.9	.....
As Rolled	54,420	90,660	8 In.—18.7	37.5	.....
As Welded	54,100	88,630	2 In.—14	.....	Weld
As Welded	53,880	89,640	8 In.—19.5	58.8	Parent
As Welded	55,600	88,900	2 In.—15	.....	Weld

Corten Steel

C	Man.	Sil.	Cr	Cu
0.09	0.22	0.508	0.97	0.38

	Y	Ult.	% El.	Red.	Failure
As Rolled	50,780	74,800	8 In.—23 2 In.—40	58	.....
As Rolled	50,790	73,310	8 In.—23 2 In.—42	52.7	.....
As Welded	50,890	75,340	8 In.—24	57.8	Parent
As Welded	50,060	74,510	8 In.—22	61.6	Parent
As Welded	50,100	73,120	8 In.—22.5	63.5	Parent

Copper-Molybdenum Steel

C	Molyb.	Copper
0.25	0.25	1.40

	Y. Weld	Y. Parent	Ult. Weld	% Red.	% Bend	Failure
As Welded	79,870	90,760	93,740	28	180	Weld
950° F.—1 Hr.	88,390	95,270	98,740	31	141	Weld

Copper-Nickel-Molybdenum Steel

C	Ni	Copper	Molyb.
0.23	0.75	1.30	0.16

	Y. Weld	Y. Parent	Ult. Weld	% Red.	% Bend	Failure
As Welded	80,590	90,880	96,460	29	149	Weld
950° F.—1 Hr.	93,870	102,920	104,620	28.8	127	Weld

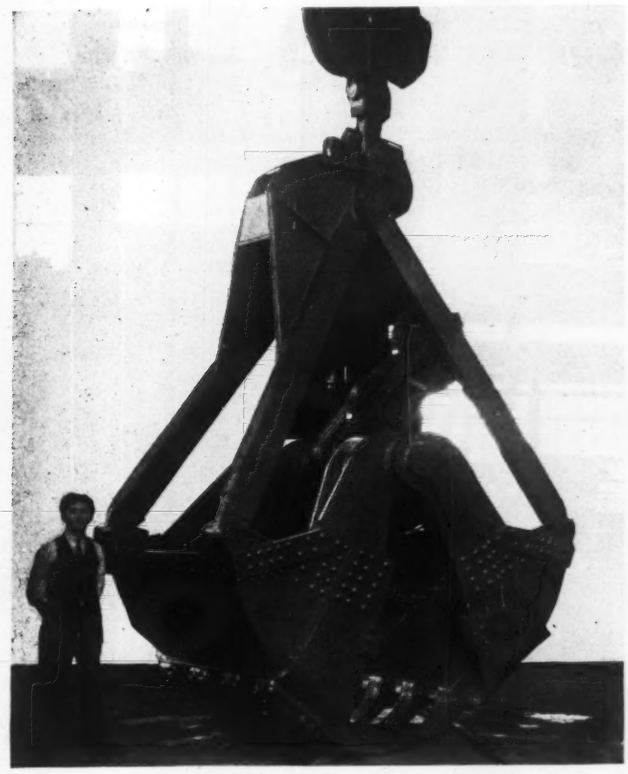


Fig. 3—Dredging bucket for heavy duty is fabricated from Cromansil steel by welding, and normalized

grades, while the higher alloys compositions have resistance estimated at from four to six times that of the regular carbon grades.

In discussing the high tensile steels in a recent paper presented before the American Welding society, A. E. Gibson, vice president, Wellman Engineering Co., stated that, "The steels generally accepted and widely used in the low alloy range, in the as-rolled condition, have yield points from 50,000 to above 70,000 pounds per square inch, ultimate strength from 70,000 to 100,000 pounds per square inch, elongation in 2 inches from 20 per cent up, free bend tests of 180 degrees and high values for fatigue and impact." A table of rolled plate and weld values of some of the low alloy, high tensile steels, indicating the high value of yield to ultimate strength with exceptional ductility, as prepared by Mr. Gibson is shown as TABLE I.

Variety of Applications Possible

A study of the properties in the foregoing tabulations and of data on additional types of the material will indicate to the designer the wide variety of possible applications for these high tensile alloy steels and thus aid in the selection of the grade best suited for a particular requirement. One point not indicated in the table is the impact strength of the steels. As a generality, it can be stated that the impact strengh of each of the compositions is considerably greater than that obtained with ordinary low carbon steel.

High tensile steels are available in shapes, plates and bars of various forms, and also in strip, sheets, light plates, rods, wire and wire products, pipe and tubular products. Furthermore, the range of rolled sections and shapes is being extended as rapidly as engineering and commercial requirements dictate.

Consider Phsychological Requirements

In considering these steels, the phsychological requirements of rigidity, often in excess of that required for strength, is important. The mental insecurity of the individual who is in contact with a structure of considerable resiliency, even though excessively strong, may lead to a considerable reluctance toward further utilization of such a structure.

Noise, drumming and echoing due to decrease of metal thickness over large unsupported areas may be anticipated in some applications and is generally objectionable. This is an additional design problem which must be overcome by the method of design or the application of silencers of felt or some other insulating material.

Working strength of the steels is generally considered as one-half the yield point. This reasoning is based on the knowledge that any load exceeding the yield point and thereby introducing permanent set constitutes failure of the part and throws the load on adjacent parts.

Flat rolled sections of the steels can be formed into structural members and framing work, while the lighter gages find use in secondary supporting members and sheathing. All grades can be formed and pressed cold, the extent depending on the ductility as indicated in the tabulated properties. Right-angle and flat bends can be made in all grades and can be produced over small radii. The "spring-back" is slight if the radius is fairly small. With larger radii, "spring back" may occur to the extent of about 25 per cent. All grades can be hot pressed, and

Fig. 4—Telescopic hoist dumping unit made of Double Strength steel can carry more material with same wheel load

the strength will not be materially affected by such working. The hardening is not excessive and the ductility is not materially reduced if the temperatures are kept reasonably low. Also, these high tensile steels can be satisfactorily worked on a draw bench; for example, moldings can be drawn in long lengths, hollow members formed and built up, and similar work executed—with excellent results. Any of the production processes can be performed on existing shop equipment.

All of the necessary complements for construction of the steels—bolts, rivets, welding rods, etc.—are available. Rivets of the smaller diameters can be driven cold and the larger sizes driven hot. No particular problems are found in the riveting, and rivets of suitable analysis are available for the various grades.

The materials can be welded satisfactorily by any of the usual methods. Some consideration

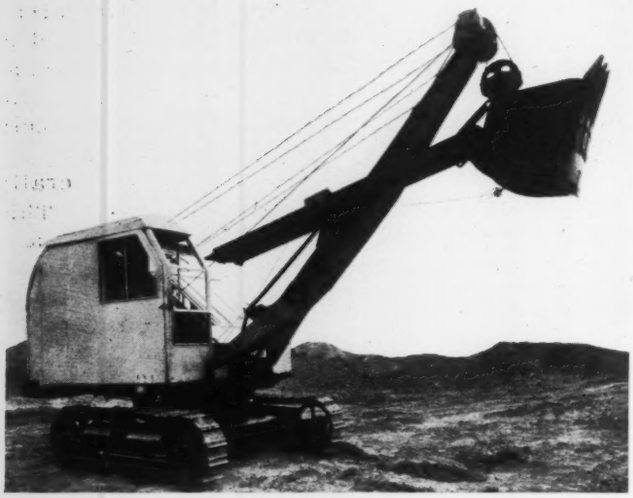


Fig. 5—The boom, dipper, dipper sticks and lower structure of this Harnischfeger shovel are Manten high tensile steel

should be given to the problems arising from reduced thicknesses involved, with the lighter gages being joined by spot welding methods. In tests made by Westinghouse with bare electrodes, low carbon steel coated electrodes and alloy steel coated electrodes (made especially for high tensile steels) the weldability in all cases was found to be good. There was a slight tendency for one of the compositions to boil at the fusion zone when welding with bare electrodes, resulting in a porous field. With these notations, the method of welding can be left to specification by the designer. Consultation with the manufacturers of the steels is advisable before the final design is completed.

Applications of the high tensile steels have been, as noted, primarily in the transportation field. However, the accompanying illustrations serve to indicate what may be expected in the future. In redesigning drag line buckets using high tensile chromium, manganese, silicon welded steel with .20 C max. and 60,000 pound yield min., a weight reduction of over 30 per cent was obtained. When it is realized that with a crane of fixed capacity one can obtain, for instance, with a two-yard bucket, an additional pay load of over 1000 pounds, and that the cycle of operation is less than one minute, the use of lightweight equipment is decidedly a paying proposition. Another of the advantages from the use of welded low alloy steel is that the

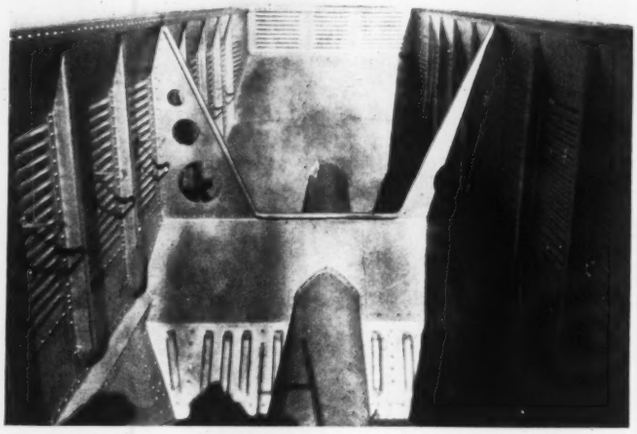


Fig. 6—Hopper cars fabricated from high tensile, low alloys sheets are better able to resist atmospheric corrosion

manufacturers are able to make guarantees undreamed of with the older cast design.

An interesting application of the steels is in the design of light-weight truck frames or mobile artillery mounts. These may be made with alloy steel castings, but the foundry difficulties in making walls and diaphragms thin, yet quite sound, are great, to say nothing of the practical impossibility of quenching an intricate member at a uniform rate. A welding of normalized copper-nickel-molybdenum plate, on the other hand, can be counted on for soundness, and its natural strength will be further enhanced by precipitation hardening effects occurring during the usual stress-relieving anneal.

As yet, applications of the high tensile steels have not been concerned with the acquisition of increased pay load through increased efficiency obtainable with lower weight in a very large number of applications, although the turbine runner in *Fig.* 2 and diesel engines are instances of this type. Such applications will undoubtedly increase in the near future, indicating again the facility with which the designer adopts any development which aids him in producing a better, more efficient and more acceptable machine.

For their courtesy in furnishing illustrations for this article and for material used, MACHINE DESIGN thanks: Carnegie-Illinois Steel Co., Lukens Steel Co., Republic Steel Corp., Wellman Engineering Corp. and Alan Wood Steel Co.

Scanning the Field . . . FOR IDEAS

BUILD LIGHTS INTO MACHINES!

BUILT-IN lighting, one of the newer ideas adopted by designers, is setting a fast pace that commands attention. The prominence which this trend has gained is comparable with that which has characterized the centralization of built-in electrical controls over the past few years. Not only does this type of lighting tend to increase the efficiency of operators through providing better vision and convenience, but it enhances the portability of the machine. The built-in fixture is always at the operator's finger tips —it requires no effort to snap it on.

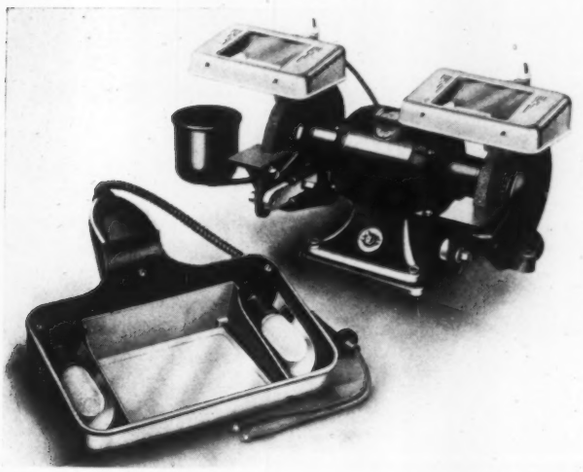


Fig. 1—Twin light safety shield provides built-in illumination that enhances design values

To insure the best possible illumination, light should come from a source at close proximity to the work, as shown by the built-in fixture on the Delta grinder in *Fig.* 1. This innovation incorporates a twin light safety shield, the receptacle serving a dual purpose. In addition to reflecting the light rays directly on the work, a pane of safety glass between the two compartments that house the bulbs protects the operator's eyes from flying particles.

In the underside view of the fixture, *Fig.* 1, can be seen the two bayonet type bulbs, polished reflectors, and neat, sturdy construction. This combination lighting unit, besides possessing the advantages discussed, adds to the appearance of the grinder.

AIR PRESSURE CONTROLS GAS SUPPLY

BY A simple arrangement consisting of a pipe connection from the air supply line to a chamber that houses a diaphragm, an automatic gas shutoff is effected. This device, *Fig.* 2, employed in connection with a Burdett industrial gas burner, terminates the flow of gas when blower *B* stops. While the air supply is being supplied by the blower, the pipe connection or "robber" *A*, conducts pressure to the underside of diaphragm *C* to raise it. When the blower is

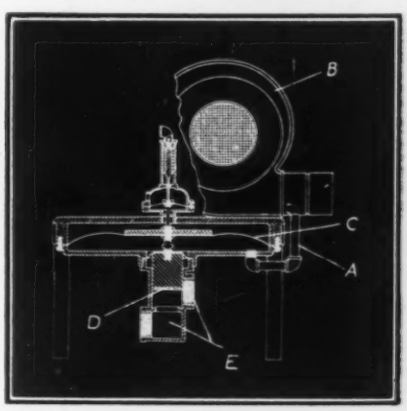


Fig. 2—By tapping the air supply line to direct pressure to the underside of a diaphragm, an automatic gas shutoff is effected

cut off by any of the automatic controls, and the pressure drops below an ounce, the descending diaphragm lowers valve seat *D* to close the line *E* leading from the gas supply to the mixer of the burner.

ELECTRONICS SIMPLIFIES DESIGN

ELECTRONIC tube action is the basis of a new and unique principle recently applied to pyrometric control. Use of this idea appreciably simplifies the design of the device, *Fig.* 3. The pointer of the galvanometer is not required to do any mechanical work to cause the relay to function, method of operation being dependent upon the simple fact that the plate current of an electron tube in oscillating condition is governed by the amount of grid excitation it receives.

As shown in *Fig.* 3, a minute flag or disk is mounted on the pointer which is attached to the moving element of the temperature measuring instrument. When this pointer approaches an electrical circuit comprising a tiny coil, forming part of the oscillator circuit, it affects the electron tube in such a manner as to cause a rise or fall in plate current. This current is used to actuate a sensitive relay containing a mercury tube and cuts off the furnace in which the temperature is being controlled.

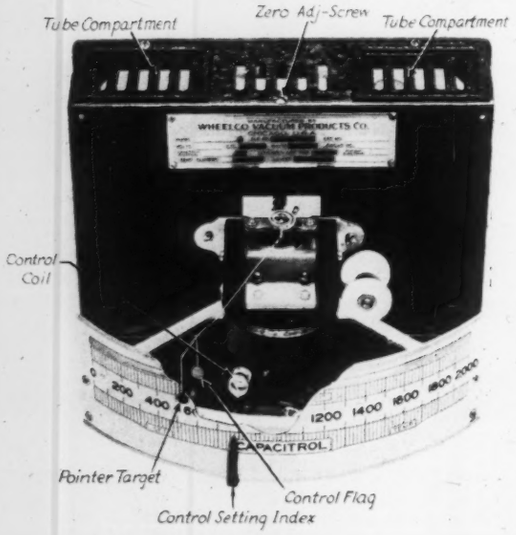


Fig. 3—*The electronic tube provides a basis for a new principle in pyrometric control*

The point at which this shut off is to occur is predetermined by the operator through the manual positioning of the control setting index. The movable table carrying an arrow-like finger to facilitate proper setting on the scale, also serves as the mounting for the tiny coil referred to above. In other words the position of the index determines the position of the coil which in turn designates the point at which an almost imperceptible movement of the pointer target and control flag causes the relay to operate. This action takes place instantaneously upon any sign of temperature change.

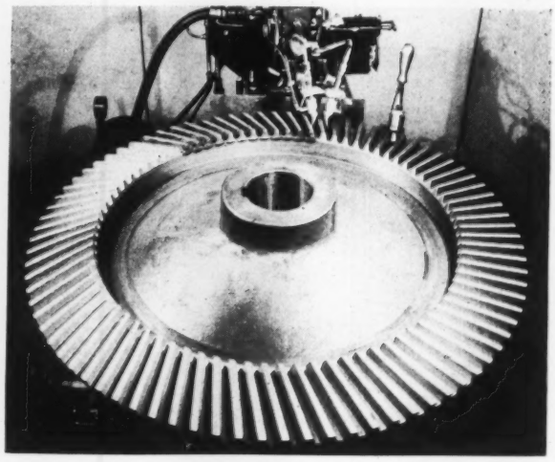


Fig. 4—*Flame hardening of gear teeth is accomplished by new type of machine*

Thermo Control Devices Inc., Chicago, is building the instrument.

MECHANIZED FLAME HARDENING

WHEN reference was made to flame hardening of machine parts in these columns in January, 1933, the idea was still in the development stage. However, the process has rapidly materialized into commercial proportions as evidenced by the new universal machine Gleason has built for surface hardening large bevel gear teeth. This is another example of an idea in the mechanical field that rapidly found its way into the design of a machine.

The process as carried out by the new unit, *Fig.* 4, opens the way to accurate and uniform surface hardening by means of the oxyacetylene flame. An important advantage is the simultaneous hardening of both sides of the tooth. Previous methods are said to have been mostly single-side hardening processes which introduced the danger of drawing or checking the opposite side. Quenching with the Gleason machine is accomplished by two small water steams directly behind the burners.

Hydraulic control embodied in the design facilitates variable speed of travel so that uniform heating of a section of tapering thickness is possible. It also allows speeding up at both ends to prevent overheating of the corners of the teeth. A wearing surface equal to case hardening can be obtained, and penetration can be

varied to almost any desired amount by adjusting the speed of travel.

CAM MOVEMENT REDUCES HANDLING

WHY require the use of two hands in operating a machine when one is sufficient? In the answer to this simple question lies the beginning of many innovations in mechanical design. A case in point is the Burpee can sealer, *Fig.* 5, which by a unique arrangement centralizes the operation of the machine in the turning of a handcrank.

In older models the handcrank revolved the can while the sealing rolls, of which there are two, required additional manual operation to effect their alternate engagement with the can. Now the new can sealers embody a cam movement that automatically draws these grooved rolls into play to form a seam that holds the lid on the metal can body, this action taking place as the can is being revolved by the handcrank.

A bevel pinion to which the crank is attached, meshes with a gear that is an integral part of the chuck against which the top of the can is forced. Frictional contact resulting from this pressure on the lid of the can causes the can body and chuck to rotate together when the handle is turned. Surrounding the bevel gear on the chuck is a spiral cam or scroll which may be considered as a one-tooth gear. This spiral

Fig. 5—*A simple mechanical movement now actuates the can sealing rolls automatically*

threads its way between successive teeth of a pinion carried by the frame of the machine. As the pinion rotates, a cam roller fixed eccentrically in the pinion follows a cam track in the slide, indicated in *Fig.* 5, carrying the slide back and forth.

A connecting link attached to the roll carrier by a pin transmits this reciprocating movement of the cam slide to the two sealing rolls, bringing first one and then the other into contact with the flange on the can body and the edge of the lid to effect a seal.

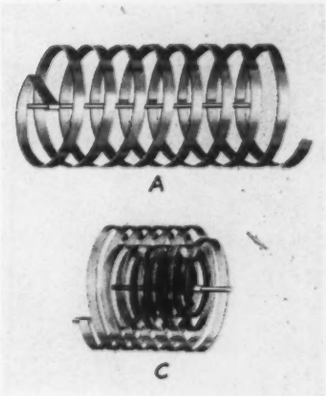


Fig. 6—*Two bimetal thermometer elements designed to provide the same deflection and torque, are shown in proportionate size. The new "Rototherm" is depicted at C*

ANOTHER NEW USE FOR BIMETAL

BECAUSE bimetal strip deflects in proportion to temperature change a new principle in thermometer construction has been developed. The idea involves a unique method of winding the strip into a unit of concentric helical coils, *C*, *Fig.* 6, so that the forces of deflection are additive, but the forces tending to cause distortion and friction are mutually counterbalanced within the coils.

Studies to provide a background for using the principle in instruments are being carried on by the Weston Electric Instrument Corp. The new form of coil first was proposed as a result of mathematical analysis by Franz G. Bloch several years ago. Because the degree to which bimetal strip bends when subjected to a slight temperature change is so small in proportion to its length, the strip usually is wound in the form of a spiral or helix to provide sufficient length to operate a pointer over a legible scale.

Bloch found, however, that both spirals and helices lack the necessary rigidity to give a true angular deflection when the coil weight and the necessary turning forces are considered. Moreover, increasing the thickness or width of the strip to provide rigidity decreases the deflection, and leads to distortion because of cross-bending across the width of the strip. Therefore, a coil consisting of concentric helices—in reality coils within coils in which all forces except that which causes angular deflection are mutually counterbalanced—was found to offer a mathematically balanced unit which was both more rigid and more compact.

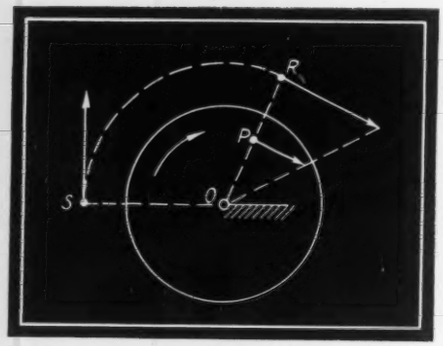


Fig. 1—It is possible to find points on the disk that will have plane motions parallel to the plane of the disk

By J. Harland Billings

Simplifying the Graphical Determination of Velocity Diagrams

CONSIDERABLE time can be saved in the finding of velocities in mechanisms by the designer who will make the small effort necessary to master the phorograph method. T. R. Rosebrugh, late of the University of Toronto, an electrical engineer and lucid mathematician, introduced the basic idea of the phorograph, but, having made the discovery of this useful method, he was content to leave to others its application in the field of kinematics and machine design. This article deals with the fundamental theory and with some applications to velocity problems. Let us first consider the basic steps in the method.

Suppose the disk in *Fig.* 1 is rotating clockwise at a constant rate about its central axis *O*. A point *P* will have instantaneous velocity in the direction shown with respect to *O*. If it is desired to find a point that will have velocity in the same direction and sense as that of *P* but of twice the magnitude, it can be found at *R* where *OR* is twice *OP*. The fact that *R* is outside the disk does not affect this conclusion if the point *R* is considered to revolve with the disk. Suppose it is desired to find a point of the disk that will have the same velocity in magnitude as the point *R* but with direction and sense vertically upward. Such a point is *S*.

Finding Parallel Motions

It is possible to find points on this disk, or of it, that will have plane motions parallel to the plane of the disk of any direction, sense or magnitude that can be specified. It is important to see that this is true regardless of the rotative speed of the disk so long as it has rotation, however small. Points at infinite radii will have infinite speeds for any finite rotative speed of the disk, and points on the axis will have zero velocity.

All mechanisms with the exception of a few unique constructions have at least one rotating part. Manifestly it must be possible to represent on this one rotating link the velocities of all points of the mechanism. The only limitation is that application is to mechanisms where the parts have coplanar motion.

Application to Mechanisms

In the quadric mechanism of *Fig.* 2 there are three parts or links that rotate, *B*, *C* and *D*. Choosing *B* as the part on which to represent the velocities of all points of the mechanism it becomes the *phorograph link*. Some point can be found on link *B* that will have the exact motion of *R*, for example. Such point is called the *phorograph* of *R* on link *B* and will be desig-

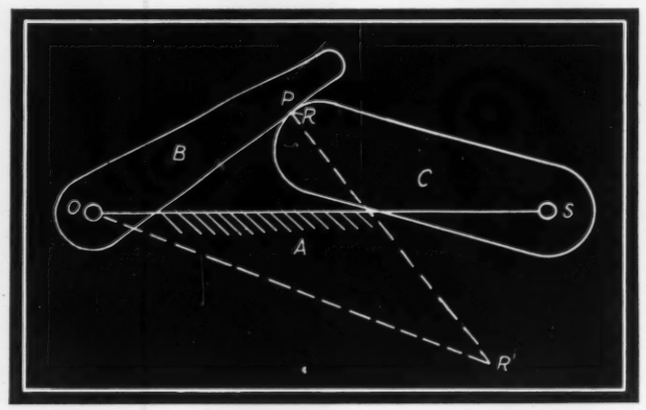


Fig. 3—Simple disk cam illustrates transmission by direct contact and where there is sliding

Computation Problems

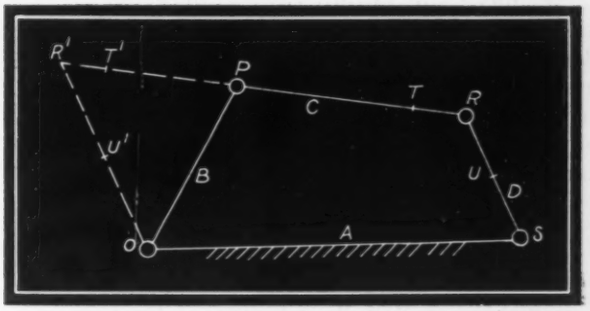


Fig. 2—In any single body or link any two points can have motion with respect to each other only in direction normal to the line joining the two points

nated as R'. The procedure for locating such phorograph will now be considered. The method will be easily grasped if one fundamental is clearly recognized. It is that *in any single body or link any two points can have motion with respect to each other only in direction normal to the line joining the two points.* Stating the same truth conversely, two points in the same body can have no component of motion whatsoever with respect to each other in the direction of the line joining the points.

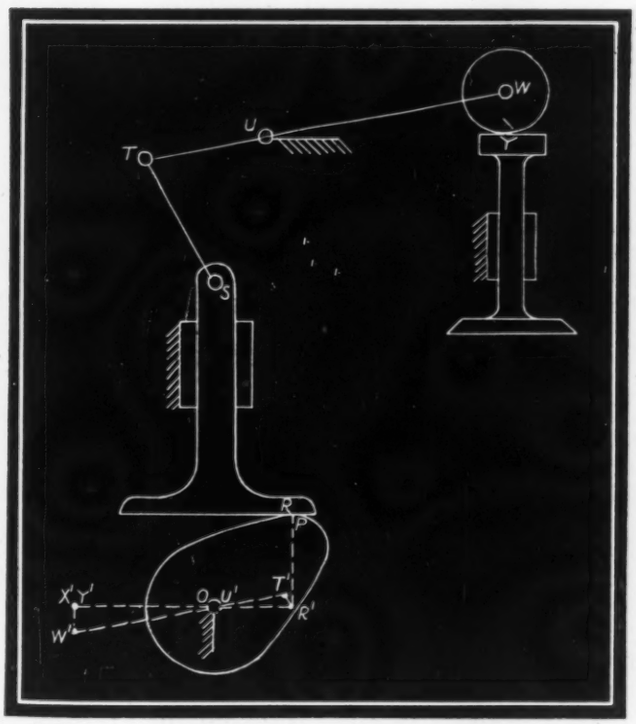


Fig. 4—Diesel engine valve gear link, inclined excessively to clarify phorograph locations

Motion Normal to Radius

The frame or fixed link of the mechanism is called A, and the axes of the turning pair connections are O, P, R and S. The direction of motion of R with respect to A, is normal to its radius RS. Points on B that have such direction of motion are found only on the line OR' parallel to D, projected infinitely either way. Further, points that have the same sense of motion as R are found only above O. It now remains to find how far out on this line R' must be.

The only motion R can have with respect to P, when the mechanism is going through the position shown, is in a direction normal to RP. R' must have the same direction of motion with respect to P. All points on B, having motion in such direction with respect to P, are found only on a line through P parallel to PR produced both ways to infinity. Hence R' is located at the intersection of a line through O parallel to D and a line through P parallel to C.

Gives Relation of Velocities

If ω_B is the instantaneous angular velocity of B in radians per second, and linear dimensions are in inches, the velocity of R equals the velocity of R' on $B = \omega_B \times OR'$ inches per second.

Further, $R'P$ must be the phorograph of the whole link C, and if T is one-quarter of the distance from R to P, then T' is one-quarter of the distance from R' to P. S' is of course at O so the whole mechanism has been phorographed on B. The velocity of any point such as U on D is $OU' \times \omega_B$.

It should be specially noted that, since the

phorographs on the phorograph link have by definition the same velocities with respect to the fixed link as have the points they represent, it follows that any two phorographs must have the same velocity, one relative to the other, as have the points they represent. In fact the phorographs are the corner points of a complete instantaneous velocity diagram for the whole mechanism.

Investigating Cam Forces

The simple disk cam, *Fig.* 3, will illustrate the case where transmission is by direct contact and where there is sliding at the contact surfaces. Cam *B* drives *C*. The contact point on *B* is *P* and on *C* is *R*. The point *R* will be phorographed on *B*. If the cams are not to separate or crush, the only possible motion of *R* relative to *P* is in the direction of sliding. The only points on *B* that have such motion with respect to *P* are to be found on a line through *P* normal to the contact surfaces. This places *R'* some place on the line *PR'*. Further, *R* moves relative to the frame *A* in a direction normal to *RS*. Points on *B* having such relative motion are to

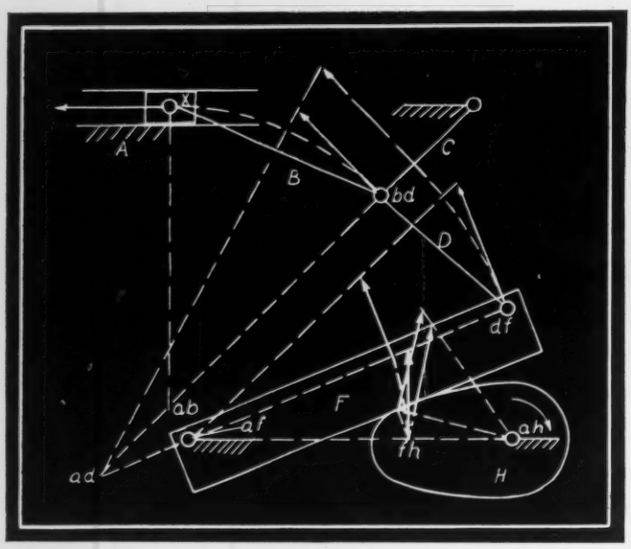


Fig. 5—Transfer of velocities is made through centros such as those shown

be found only on a line through *O* parallel to *RS*. The intersection locates *R'* which by definition is the point on *B* that has the same instantaneous motion relative to all other points as has *R* on *C*.

Presents Relative Velocity Relations

The relative angular velocity relations follow directly. The linear velocity of *R'* is $OR' \times \omega_B$ and equals the linear velocity of *R* which is $RS \times \omega_C$, from which

$$\omega_C/\omega_B = OR'/RS$$

Fig. 4 represents a diesel engine valve gear except that link *ST* is inclined excessively to clarify the phorograph locations. It is probably most useful to phorograph on the constant speed cam. The link *RS*, having rectilinear translation, is represented in all its points by *R'*. *T'* will be located at the intersection of *R'T'* parallel to *ST* and *OT'* parallel to *UT*. The proportion

$$W'U'/U'T' = WU/UT$$

locates *W'*. *X'* is on a vertical through *W'* and a horizontal through *O*. Since *X* and *Y* are contact points in pure rolling they have the same velocity and therefore the same phorograph. The instantaneous velocity of the valve is then the angular velocity of the cam multiplied by the distance *OY'*.

This simple construction for the location of *Y'* for successive positions of the mechanism

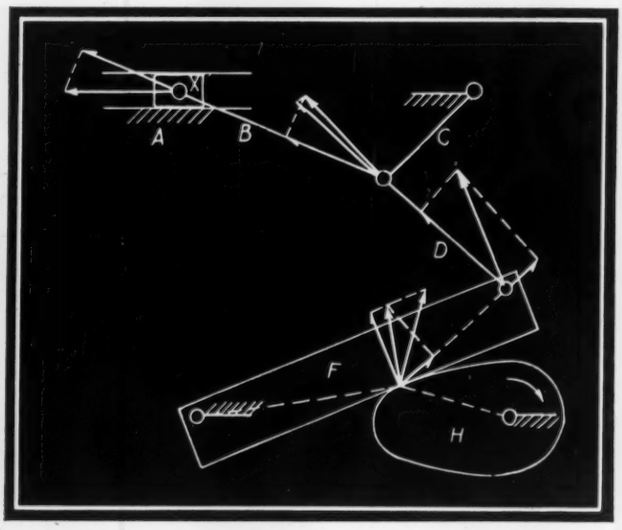


Fig. 6—Component method as illustrated requires precision of draftsmanship for accuracy

makes the plotting of a velocity diagram for the valve both speedy and accurate. In general, the more complicated the mechanism the greater the advantage of the phorograph method.

Compares Available Methods

The relative amount of work required and probability of error can best be judged by observing the common methods for obtaining velocity applied to the same mechanism. The toggle mechanism of *Figs.* 5, 6 and 7 is of identical dimensions and phase in each case. The cam drive has been introduced to illustrate the treatment of the direct contact transmission by the three methods. In each case the speed of the driving cam is supposed to be known and that of the platen or ram *X*, is to be found.

Fig. 5 illustrates the "transfer" or "centro" or "instantaneous center" method as it is variously called. Starting with a vector to repre-

sent the velocity of the contact point on the driving cam *H*, transfer is made through the cam centro *fh*, thence through the centros *df* and *bd*. In all cases the vectors are to be measured from the point of the arrow to the *center* of the circle representing the turning pair. Vectors representing *components* of velocities are tipped with a half arrow. This method is so thoroughly covered in standard books on mechanism that a detailed description is unnecessary here.

The "component" method is illustrated in *Fig.* 6. This is based on the principle that for any two points on the same link, their components

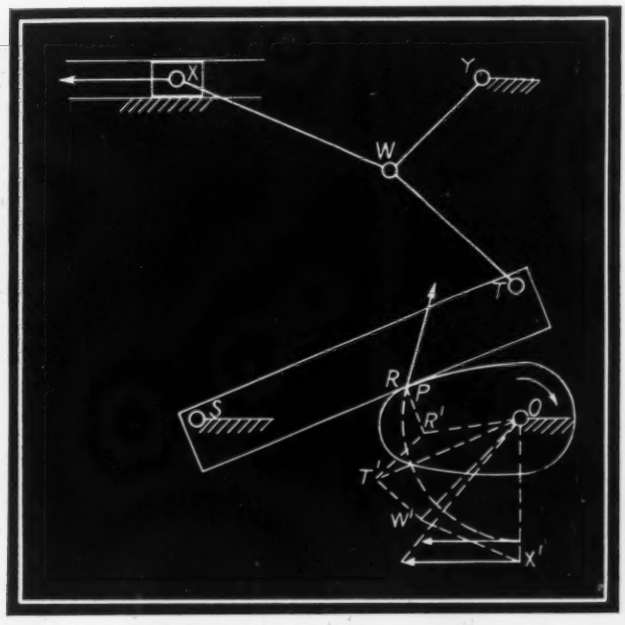


Fig. 7—Probability of error is reduced in about the same ratio as the amount of work required

of velocity in the direction of the line joining them must be equal. While this method is simple and direct it requires precision of draftsmanship for reliable results. For example, the operation at the connection between *F* and *D* can easily result in considerable error.

Phorograph Solution Shown

The phorograph solution is shown in *Fig.* 7. *T'* is at the intersection of a line through *R'* parallel to *RT* and a line through *O* parallel to *ST*. If this intersection is at a small angle the position of *T'* should be checked by using the proportion

$$T'R'/R'O = TR/RS$$

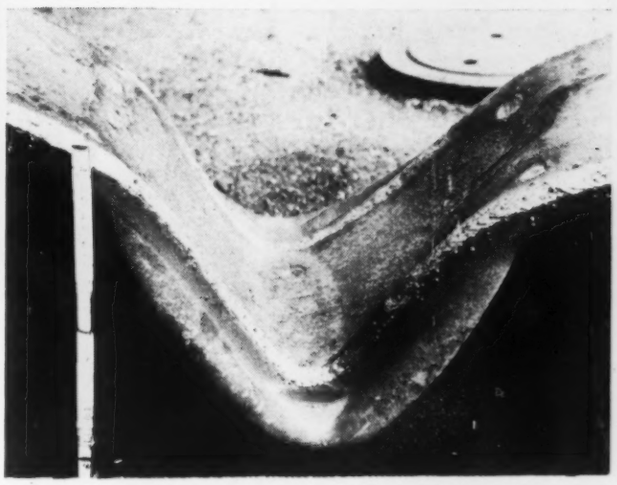
Experience indicates that the probability of error is reduced in about the same ratio as the amount of work required.

For further study of the phorograph method the reader is directed to an article in the September 1934 issue of MACHINE DESIGN by Prof. M. F. Sayre, also to the following books: Robert W. Angus, *Theory of Machines,* McGraw Hill Publishing Co., and J. Harland Billings, *Applied Kinematics,* D. Van Nostrand Co.

Unusual Test Determines Impact Strength of Welds

POSITIVE determination of the homogeneity of welds is now a comparatively simple process. Physical tests of welds are following the usual standard procedure and producing accurate results. However, Marietta Mfg. Co., Point Pleasant, W. Va., went far beyond the usual methods of testing in adopting a simple but unusual means of determining the impact values of welds in the construction of oil barges.

This company built up a 12-inch box section by welding two standard 12-inch channels together with ½-inch plate 12 inches wide. This box section was placed on railroad ties spaced



Unusual impact test, utilizing an enormous amount of energy, indicates the quality of welds

8 feet apart. Then an 180-pounds weight was dropped on the test piece approximately 100 times, starting from a height of 3 feet and continuing until a maximum of 6 times from 50, 60 and finally 75 feet was reached. As can be imagined, the force developed by this weight falling from a height of 75 feet was far more than that which would be encountered in actual service.

The condition of the test piece after completion of the test is shown in the accompanying illustration. The weld was a ½-inch fillet weld made in two passes with shielded arc welding equipment supplied by the Lincoln Electric Co.

COLOR

A Review of Three Notable Monographs

CHOICE of color for machine finishes should not be guesswork. Rather, it should be based largely on certain fundamental principles. But this raises the question of where data of this nature is obtainable. One source of information that can be studied profitably by the designer of machinery lies in the three new monographs recently brought out by the research laboratories of the International Printing Ink Corp.

Data Has Design Value

While they are not written for the engineer, they give basic studies in color, including illustrations and charts, that can readily be adapted to the mechanical field. Although the first book is devoted to color chemistry with which the average designer may not be vitally concerned, its perusal is worth while.

"Color as Light," the second volume in the series, contains a discussion that fits the machine field to a large extent. For example, this book takes up a problem that is ever present in the selection of colors. Many colors are considerably altered in their appearance by a change in the type of illumination under which they are examined. A purple area is so called because of its appearance under daylight. It will look redder, however, under tungsten light and bluer by north skylight. This is to be expected because purple has a high reflectance in both the red and violet ends of the spectrum. Under daylight, which has a nearly uniform distribution of energy throughout the spectrum, the combination of red and violet produces a purple sensation in the eye. Tungsten light, on the other hand, will subdue the violet and emphasize the red, while north skylight will suppress the red and emphasize the violet.

Another point brought out in this section of the series may be of interest. When the color of a pigment is stronger than desired, it is common practice to "extend" it with white, the resulting mixture being called a tint. Here the relative size of the particles of the white and of the colored pigment is important. If the colored particles are smaller than those of the white, they will surround the white particles and produce a darker tint than will result if the colored particles are larger than the white particles.

In the third volume, "Color in Use," the data will serve the designer to a more practical extent than that of the other two books. The user of color must be able to anticipate the often surprising action of color as the eye sees it, which is loosely called "the psychology of color." He must realize, the discussion continues, that a color which satisfies the chemist's and physicist's standards may not be satisfactory as the eye sees it, for the purpose for which it is to be used.

Color Requires Careful Selection

The well-known and widely used system of color notation developed by Prof. Albert H. Munsell is explained and illustrated. The discussion may be summed up thus: "While genius may work in violent color combinations, those of lesser talent must play safe. Satisfactory results may be achieved if we use colors of low values and weak chroma for our larger areas

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Machine Safety—

A Design Necessity

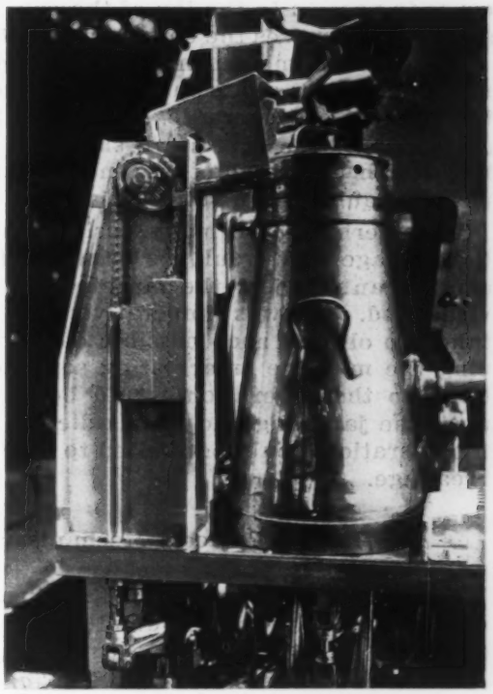


Fig. 1—A spring in the tube shown at the left obviates possible breakage

WHEN a machine is designed to run automatically with an absolute minimum of attention, and when the operators of the machine are not experienced mechanics, it is absolutely necessary that mechanisms which will safeguard the unit from accidental damage be built into the design. This protection is not necessary from the standpoint of the efficiency of the machine, this being amply taken care of in the design department, but results from the possibility of the products being treated jamming some section of the unit and causing untold damage to the entire machine.

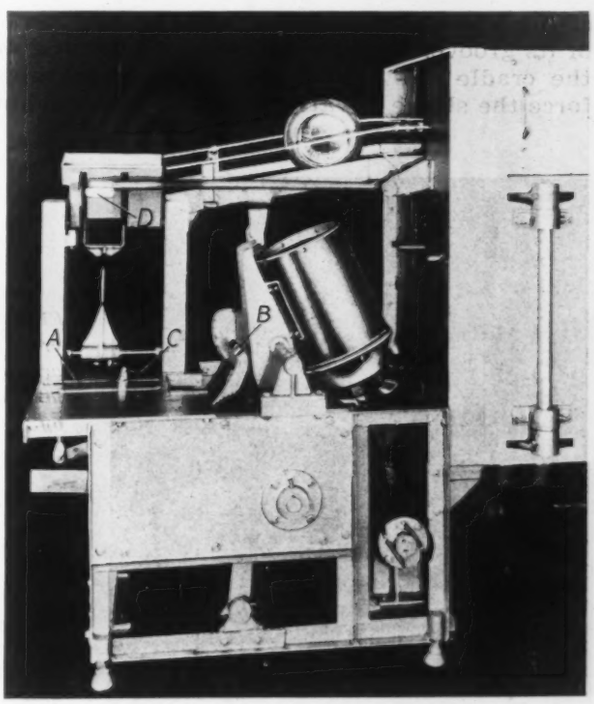
A design in which this necessity for safety mechanisms was carefully considered is the milk can washer built by Rice & Adams Corp., Buffalo, N. Y. The delivery end of this washer operates on an entirely new principle, and it is this section of the machine where the safety devices are desirable.

Cradle Rotates Continuously

In order to understand the application of these devices, it might be well to outline the operation of the delivery mechanism. Contrasting with previous designs, the can turn-over is a rotary action rather than a whipping action occasioned by a reciprocating cradle into which the cans fell after passing through the washer. In this rotary action the can is lifted clear of the can track rails by the cradle, seen in *Fig.* 2, which continues its circular movement. The removal of the can by lifting eliminates the former method of allowing it to fall into the cradle. Directly above the can the lid or cover starts to roll down the incline into the cover hopper which at this stage is in a vertical position to receive it.

As the cradle rotates it delivers the can to the delivery table, levers rising through the slots *A* in *Fig.* 2 to receive it and ease it on to the table. An arm at *B* lifts the can from the cradle and advances it to the table. This arm continues to move the can forward until it is well to the back of the table, from which point

Fig. 2—Cans are turned over by a positive rotary motion rather than by reciprocation



the small levers *C* in *Fig.* 2 push it on to a conveyor.

During this action the cover has rolled to the cover hopper which at the proper moment is turned to a horizontal position, allowing the

cover to pass on to the top of the can. The arm shown at *D* presses the cover firmly into the can.

All of these movements are accomplished by means of levers and cams with the exception of the rotation of the cradle. A few of these cams and some of the levers are shown in *Fig.* 3. It is through the use of these mechanisms that a positive, quieter can rotation is made possible.

Considering these many positive movements, the damage that would be occasioned should a can or can cap jam the machine can easily be visualized. It was imperative that steps be taken to obviate such possible damage by stopping the machine or arresting some of the motions so that operation would be discontinued until the jamming had been relieved or so that the operation would be limited to insure against breakage.

Spring Protects Mechanism

The first step for protection against jamming was taken at the shaft around which the cradle rotates. This shaft, shown in *Fig.* 4, takes its rotation from the main shaft in *Fig.* 3 through a chain from the sprocket at *E, Fig.* 3. On the cradle shaft is mounted a sleeve at *G, Fig.* 4, keyed to insure positive driving yet so mounted that it can slide endwise if necessary. This sleeve transmits power from the shaft to the cradle by means of the roller at *H* and cam faces. Should a can jam the cradle, the spring shown would give and the roller would rise out of its groove. With the sleeve still turning and the cradle still jammed, the cam faces would force the sleeve toward the side of the machine

This movement would then turn the small lever *I* which is mounted on a free shaft. Mounted on the other end of this shaft is another lever which can be seen at the switch. A turning movement

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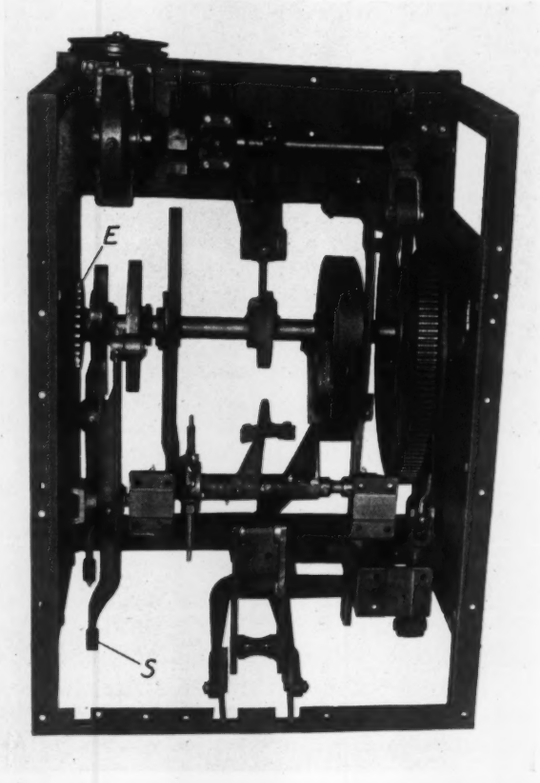


Fig. 3—*As can be seen, major motions of delivery mechanism are of the cam and lever type*

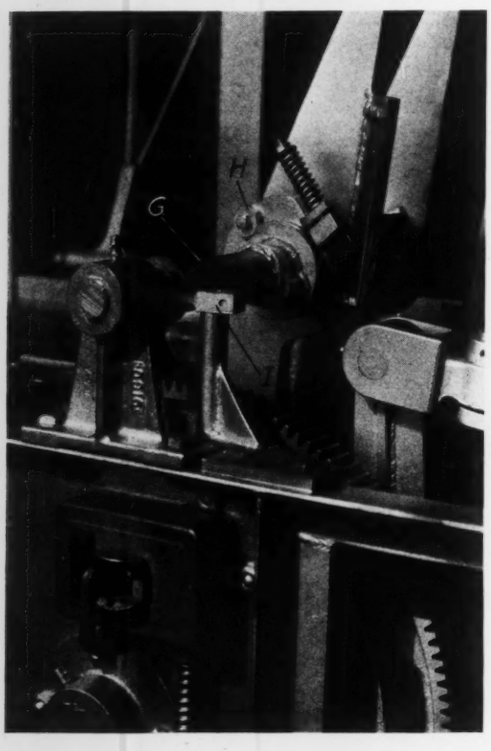
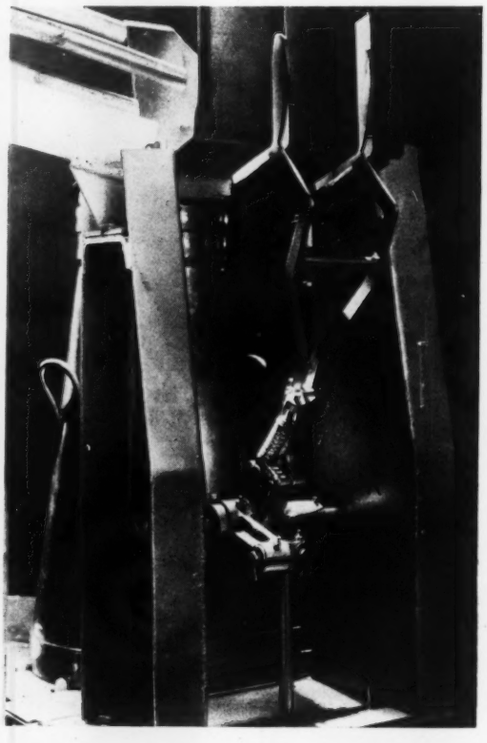


Fig. 4—*Left—A roller, slipping from a groove in case of jamming, will turn off the switch and stop the machine*

Fig. 5 — *Right — Spring-retained levers, as shown, are reliable safeguards against unforeseen circumstances causing damage*



Studying Gear Steels with the Microscope

By John T. Howat

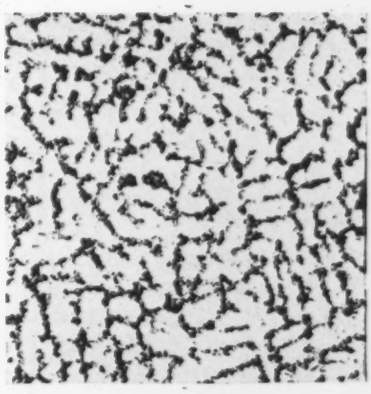


Fig. 1—Medium carbon steel annealed—showing ferrite and pearlite

Fig. 2—Hardened carbon steel — showing martensite and primary troostite

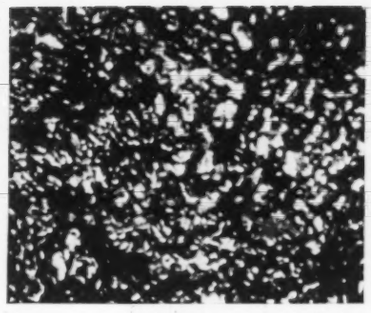


Fig. 3—Martensitic structure with increasing troostite and sorbite

CONSTANT demand for better materials has made the study of metals for gearing of maior importance to design. In this article, abstracted from a paper presented at the recent Gear Manufacturers meeting, Mr. Howat, Pittsburgh Steel Foundry Corp., indicates how to obtain better results

Fig. 4—Lammellar pearlite plus some sorbite and ferrite

CONSTANTLY changing conditions confront the gear metallurgist and the designer. A few years back a cast gear in steel or iron made within casting tolerances was considered standard production; now, the metallurgist has to produce a machined tooth gear with physical values at least three to four times those of the old gear.

The natural sequence of such demands has been the reducing of old tolerances and the drawing up of new standards governing raw materials, combined with much closer control of processing methods.

The main material used to make gears is steel, having as a base iron with small percentages of phosphorous and sulphur as impurities to which is added carbon, silicon, manganese, nickel, chromium, molybdenum, and vanadium in varying proportions to meet the specific requirements of the gearing. Physical properties of steels can be increased by adding these carbide forming elements or by suitable heat treatment. Carbon is naturally an active carbide forming element so that carbon steels are used in making the largest percentage of our gears.

A. G. M. A. standards for gear materials, which have been drawn up from years of experience, show that a carbide forming composition most suitable for economical production should be equivalent to a .30 to .40 carbon for cast steel and a .40 to .50 carbon for forged steel. These medium carbon steels give well balanced physical values on heat treating that will meet most of the present day service requirements, namely: High elastic limit for fatigue and impact resistance, proportionate elongation and reduction of area for ductility, and a high brinell for wear.

Physical strength of any metal is dependent on its microstructure, and the size of its grains combined with the cohesion between its crystals determines the final physical values obtained from that metal. A fine-grained structure can be produced by composition or forging, but the necessary cohesion between crystals and the microscopic grain refinement can only be fully produced by quenching and drawing the steel.

Fig. 1 shows the usual ferrite and pearlite structures which

carbon steels have at normal temperature. If we heat a steel of this type to 1350 degrees Fahr. the carbide of iron and ferrite forming the pearlite areas unite to form a solid solution. On raising the temperature still further, the ferrite or alpha iron is also dissolved to give a solid solution of gamma iron or austenite. This condition is what we must have in any steel before quenching if we desire to obtain the best physical results from the steel irrespective of its analysis.

Time Allowed Is Important

The time allowed for the passing of the steel through the 1350 degrees Fahr. range to the quenching temperature used plus the time allowed for quenching with all other factors being correct will establish the state of the steel for final treatment. It is but natural that the higher the percentage of carbides in the steel, either of iron or complex double carbides formed by carbon or alloy additions, will necessarily need more time for diffusing to form the austenitic condition. If insufficient soaking time is allowed for either the plain carbon or alloy steel, we have residual ferrite and carbides still present in the austenite when the steel is quenched. The effectiveness of the quench is reduced and will be evident in the non-uniformity of the final results. Quenching from too high a temperature or holding too long at a high temperature will produce a coarse grain with undue brittleness and subsequently greater internal stresses. The excess temperature also reacts on the quenching medium and if same is small in volume, may cause irregular hardening due to the liquid becoming too hot.

When the steel has been properly hardened, we obtain a martensitic structure as seen in *Fig.* 2. This material has a brinell hardness of 420 to 650; it is distinctly brittle, strong and hard in appearance and characteristics. It must be supported in correct proportions with the proper lower hardened constituents to give satisfactory service results. We seldom, if ever, obtain a 100 per cent martensite structure, but may have small amounts of austenite or primary troostite present with the martensite. If austenite is present, it may change over to martensite on tempering or drawing and the steel will have become harder after this treatment.

May Obtain Higher Brinell

This reaction explains the higher brinell sometimes obtained on retesting after the drawing treatment and usually necessitates a second treatment to obtain the correct hardness. If the quenched steel is heated to 375 degrees Fahr., we immediately start a decomposition of the martensite to form secondary troosite, *Fig.* 3 which has a brinell hardness of 350 to 425, and on continued heating to 525 degrees Fahr., we have further breaking down of the troostite to give sorbite, *Fig.* 4 with a brinell of 250 to 350.

Both of these microconstituents are essential in heat treated gearing as they soften the martensite field and reinforce the teeth with a toughness necessary to withstand high impact and fatigue stresses. It is a well recognized fact that the desired structure in the teeth of a quenched gear is a martensitic structure plus a small amount of primary troostite for a depth of about ⅛ inch to at least ½ inch below the tooth face depending on the pitch of the gear. With a gradual changing over to a troostitic and sorbitic core structure and with the larger pitch gears, some pearlite and ferrite will also be present.

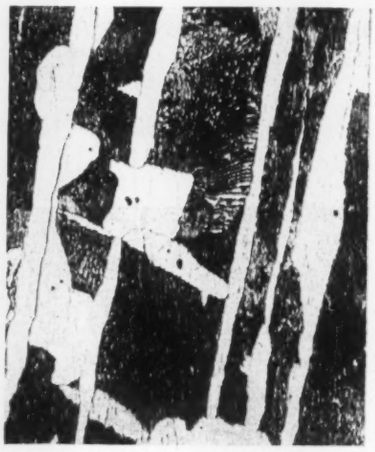


Fig. 5 — Steel having .30 carbon with large ferrite structure. Magnification is 200X

Quenching Strains May Cause Failure

A short explanation of the dimensional changes that take place on heating and quenching a piece of steel may explain why excess quenching strains cause most gear failures. As steel is heated it expands until 1350 degrees Fahr. is reached; then, as the ferrite (alpha iron) changes into austenite (gamma iron) it shrinks in size because this phase of iron is more dense than the ferrite. When this change is completed, the austenite expands, which is the condition of steels when ready for quenching. While the steel is changing from austenite to the martensite point, it contracts as it cools and as soon as the outer surface has been changed to martensite, it continues to contract. Since martensite contains alpha iron which has greater volume than gamma iron, we get an expansion on cooling of the martensite, and as the metal cools to the lower constituents, it keeps expanding due to the formation of more alpha iron.

It can readily be seen that in one piece of

steel we may have from maximum expansion to maximum contraction if not properly heated before quenching, and it is this condition which intensifies the natural strained conditions set up by quenching. Normal quenching will always set up strain due to nonuniform sections; therefore, we must try to minimize the amount of uneven stressing with the gear. When the total stresses due to improper heating or excess quenching exceed the elastic limit of the material, then cracking occurs. The minimum amount of quenching done to produce the desired results will result in lower internal strains and therefore a safer gear.

Many opinions show the teeth up-rooted across the full face of the pinion, taking a portion of the base material with them. The exposed fractured surface has a typical woody or fibrous structure running parallel with the face. The pinion blanks may have been cut from a hot rolled bar with no attempt to refine the grain by forging or annealing with the result that

Fig. 6—Changes in structure of the steel shown in Fig. 5 after annealing are easily seen

the original elongated structure still persists even after heat treating.

Fig. 6 shows the ferrite and pearlite banded structure from hot rolled material which should be broken up by forging or annealing to give the best results on heat treating. Commercial hot rolled bars are often rolled at too high a temperature due to high speed production, or a breakdown in the mill may cause the over soaking of the billets in the heating furnaces, with the result that from both these conditions we get a large grain size of a banded type which is extremely difficult to break up with annealing or quenching.

The tooth loads which can be successfully transmitted by pinions having a banded structure will have to be less than the fatigue limit of pure ferrite which will be approximately 15,000 pounds per square inch. Pinions, to be used in highly stressed services or to be heat treated, should be well annealed and purchased from a reliable source of supply. The true solution to this type of failure is to use forged bars for stock material or upset pinion blanks (a blank made from a billet of such size that the finished surface material for a depth of at least ½ inch below the root diameter of the finished pinion will have been changed from a rolled or elongated structure to a refined or forged condition).

When a carbon steel gear hardened to its maximum safe hardness limit will not produce physical values high enough to meet a specific service condition, or the design of the gear will not permit of water quenching, then we must resort to an alloy steel suitably heat treated. Alloy steels in their many combinations of the elements listed in the early part of this paper will give a wide range of physical values on heat treating. The presence of nickel in these steels helps the solubility in the ferrite of the new carbides primed by the addition of these alloys.

Most of the complaints on oil treated gearing are from cracking. The microstructure of the alloy steels are naturally much finer grained than the carbon steels, because of the presence of the increased amount of carbides. On quenching these steels, martensite is formed to a greater depth than with the plain carbon steels so that alloy steels must be carefully quenched and drawn to a greater extent to insure fuller relieving of the quenching strains.

Percussion Welding Advances

INCREASING use of alloys of aluminum, copper and corrosion resistant metals has stirred up considerable interest in the resistance welding process known as "Percussion Welding," broadly described as the concentrating of relatively large quantities of both electrical and mechanical energy at the point of engagement between the members to be welded for an almost inappreciable length of time. During the past few years devices have been developed that restrict the duration of current flow to one or a fraction of one cycle of alternating current.

The chief advantage of this short current duration is that it can be applied to metals having critical welding temperatures. Theoretically, the best weld is obtained when the area heated to welding temperature is limited as nearly as possible to the surface to be joined. A further advantage is that it produces less upset in the case of a butt weld and less indentation on the outside surfaces in the case of spot welds. Usually there is a slightly lower total kilowatt hour consumption of current, and, in some cases, an increase of production. Although percussion welding was originally used for welding condensed sections, engineers of the Thomson-Gibb company consider there is, theoretically, no limit to the cross-sectional area which can be welded by this process.

Standardization Aids in Design of Loading Units

By P. A. Smith
Engineer, Barber-Greene Co.

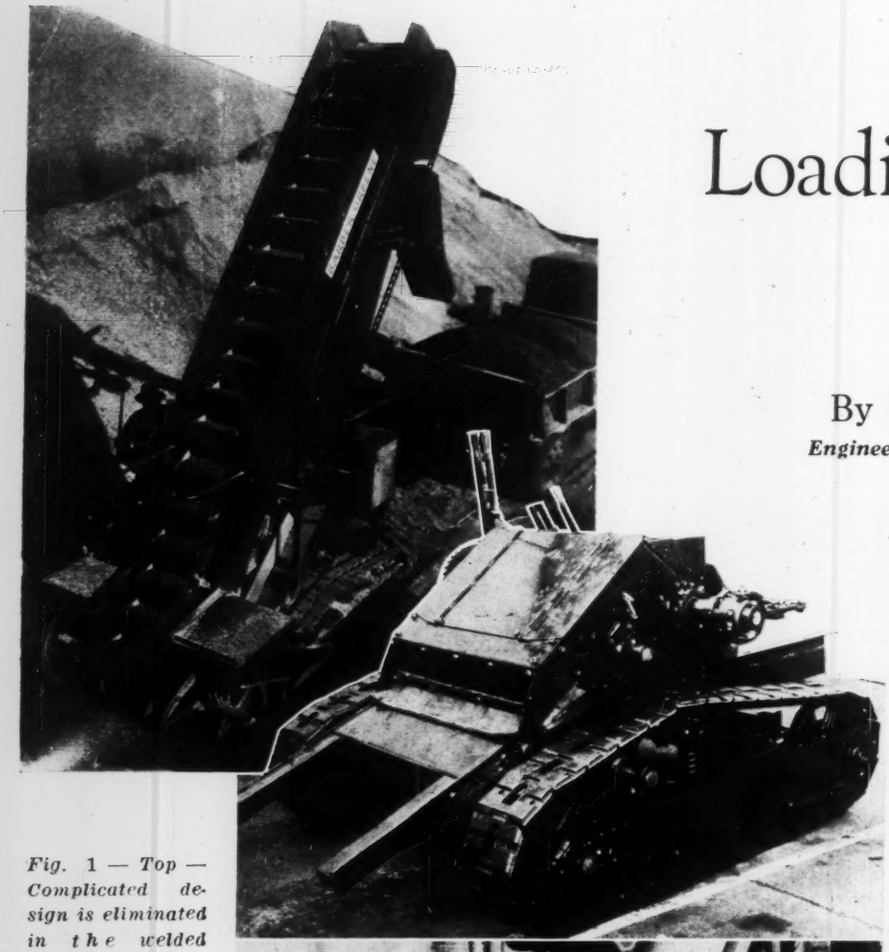


Fig. 1 — Top — Complicated design is eliminated in the welded boom of loader

Fig. 2—Center— This standard tank-type chassis frame serves several machines, thus effecting economy in manufacture

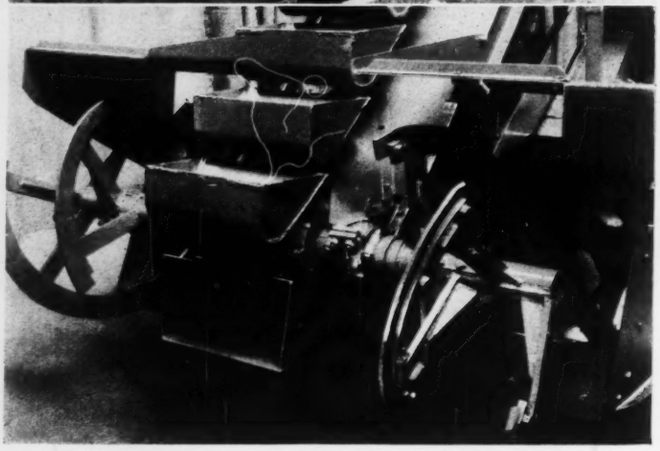


Fig. 3—Bottom— Hard-facing material protects bucket lips from wear

STANDARDIZATION is perhaps the greatest single factor in reducing manufacturing costs. This procedure not only effects economies in production of individual machine parts, but lends itself to the work of any design department responsible for a line of machines that have certain features in common. Often it is possible to utilize a standard frame assembly or other such unit for several machines, thus realizing the advantages resulting from mass production.

A good example of standardization in design is furnished by the engineering department procedure of Barber-Greene

Co. which employs the same tank-type chassis frame, *Fig.* 2, for several of its machines, including a coal-loader snow loader, and a bucket loader. This standard chassis permits considerably lower manufacturing costs. Of particular note in connection with the construction of the chassis frame is the fact that it consists merely of a welded "box" of ¼-inch plate. All driving mechanisms are housed within the box. The crawler pivot axle also is located in the base, and two 8-inch angles, welded to the box, support the engine and transmission. Furthermore, all levers and controls are assembled on this basic frame unit.

An additional advantage of this type of construction is the elimination of a complicated channel frame and cross bracings. In other words, the main frame is tied into a compact integral unit of considerable strength. When the chassis is used in the construction of a bucket loader, *Fig.* 1, a superstructure, also of welded design, is bolted to the box unit to form the composite machine.

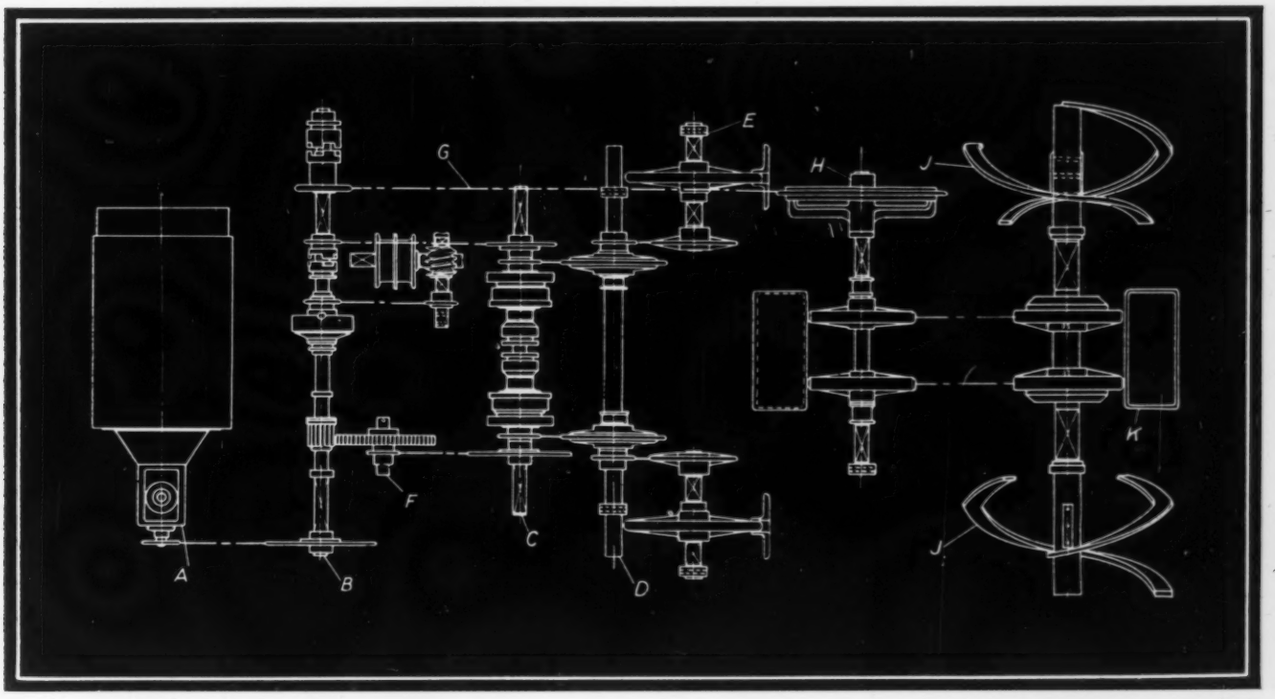
Chain Drives Used Extensively

Driving mechanism, *Fig.* 5, of the bucket loading machine is characterized by an extensive use of steel bushed roller chain drives, totally enclosed in the dirt-tight chassis frame. Two hinged covers on the top permit easy accessibility for adjustments and lubrication. Main drive is by chain from engine transmission *A* to jackshaft *B*. From this point the drive is taken through a clutch shaft *C* and oscillating shaft *D* to the crawler *E*. A slow speed shaft *F* permits slower travel of the unit for feeding, through reduction gearing. It will be noted that driving chain *G* conveys power to the head shaft *H*, at the top of the superstructure, which operates the loading bucket line.

In order to synchronize the conveying spirals

Fig. 4—Above—Damage to loader mechanism is prevented by overload release device that is located at the head of the boom. Note use of springs

Fig. 5—Below—Steel bushed roller chains are used extensively throughout the machine. Driving mechanism is housed in the dirt-tight chassis frame



J that draw the material into the path of the loading buckets *K* (also see *Fig.* 3) the chain drive to these members is taken from the head shaft *H*. There is a double spiral on each side of the bucket line, in staggered position as illustrated, providing an individual feed for each bucket. With a double pitch spiral extending to the end of the spiral shaft and a single spiral completing the circle around the feed shaft, more uniform flow of material is carried to the buckets.

Wearing Strips Protect Spirals

Welded construction also is employed in these spiral feeders which slip over and are bolted to the driving shaft, a feature that makes them easily replaceable. To reduce wear due to the abrasive action of sand or other material handled, replaceable wearing strips of heat treated alloy steel are bolted to the rims of the spirals. The buckets of the conveyor also are protected against wear by a hard-facing material applied in welding rod form to the corners of the front and side lips, as depicted in *Fig.* 7. These buckets, now fabricated by welding, were formerly produced as castings.

Carrying the buckets up the incline of the superstructure are two strands of long-pitch roller chain running over chilled head sprockets and carbo-manganese steel foot sprockets. The elevator boom that carries this bucket line consists of two 6-inch channels. Power for the bucket line is transmitted through a single strand of chain, as previously discussed, to the overload release sprocket, *Fig.* 4, located at the head of the boom. By incorporating this mechanism in the design of the loader, damage to the unit is obviated should the buckets encounter an obstruction. The sprocket of the mechanism drives through a central member that maintains spring contact with two cams on the inner rim of the sprocket. When overload occurs the springs will of course compress, allowing the cam rollers to ride over the cams until the bucket line becomes released.

Fig. 7—Close-up view of welded buckets shows extensive application of hard-facing material to resist abrasion

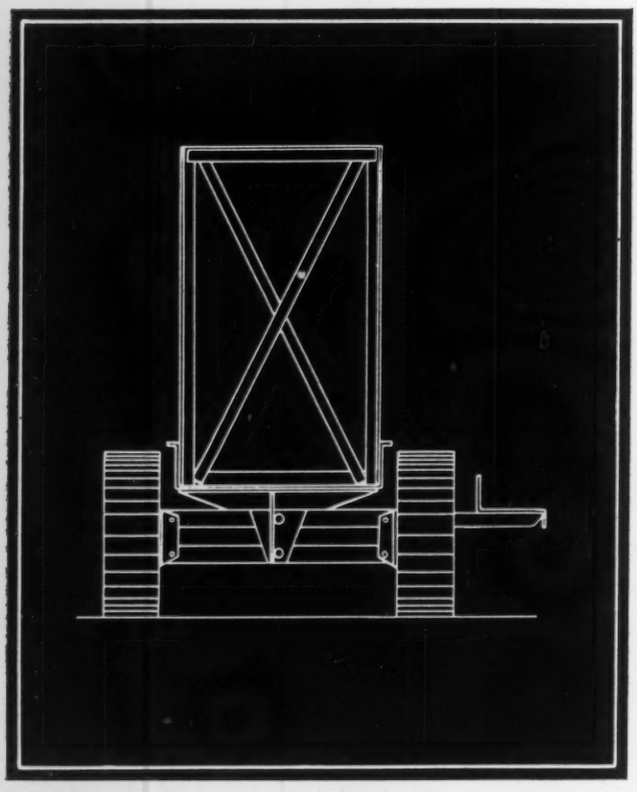


Fig. 6—Two cross axles assembled as a parallelogram provide knee action for the crawler unit, permitting maximum contact with the ground at all times

Boom Employs Floating Principle

By employing a floating boom principle, the designers have made it possible for the crowding thrust, when the loader is moved forward into the material being handled, to be transmitted through arms direct from the crawlers to the feeding end of the equipment. Consequently the necessity of putting this strain through the superstructure frame is avoided. Floating is accomplished by means of flanged

wheels mounted midway up the boom, which ride on curved tracks on top of the main frame. This floating feature increases flexibility and facilitates lowering of the superstructure for traveling.

Possible spillage from the buckets at the discharge point is carried directly back to the spirals by a steel chute, this being fully enclosed at the head end to protect the operator. A handwheel located on the boom and in convenient reach of the operator, quickly regulates the direction of discharge of material through the swivel spout, and automatically locks it.

In line with recent trends in automotive design, a knee-action oscillating axle is employed to allow maximum contact with the ground at all times. This idea in crawler suspension embodies the use of two cross axles assembled as a parallelogram, *Fig.* 6. By this means, the crawlers also are prevented from "toeing in" when steering, and bending stresses on the pivot axle are relieved. The main structure is mounted by three-point suspension.

Torch Cutting Improves—Design Benefits

SOME measure of the progress in oxyacetylene welding and cutting can be obtained by comparing present attainments with the fact that only fifteen years ago the oxyacetylene torch was considered by many as somewhat of a novelty. Importance of this industrial development is emphasized by the interest that was shown in the annual meeting of the International Acetylene association in Cleveland recently.

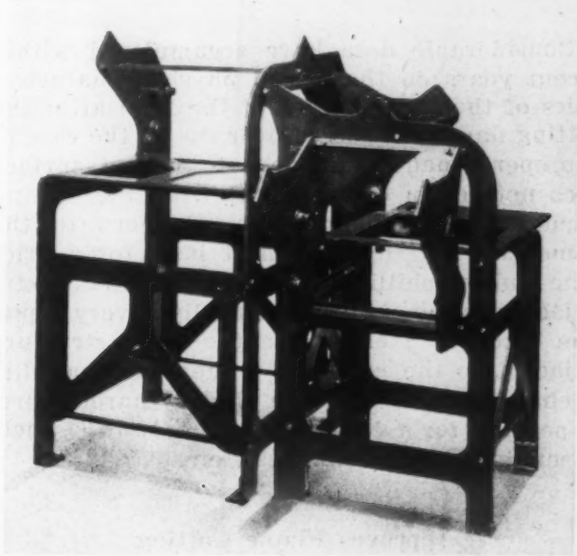
Probably no better picture of actual accomplishments can be found than indicated in the report of E. V. David, general chairman of the oxyacetylene committee. Mr. David quoted an automobile executive who, when asked what part welding and cutting played in producing his popular-priced car, replied: "They made it possible." This statement is significant of the value that these processes hold for designers of all types of machinery.

Welding Aids Appearance

Welded seams and cut edges, it was pointed out, are smooth enough for many purposes without further finishing, but can be ground to a still greater degree of smoothness and made invisible where necessary. When a call for industrial beauty rang out there was a new process which fitted into the picture perfectly, the speaker said.

Discussing welding particularly, Mr. David alluded to a recent case of bronze welding in construction of a steam anvil hammer weighing 13,000 pounds which was fabricated by a Midwestern railroad shop. The cast iron bottom and steel top of the hammer were bronze welded together.

Oxyacetylene welding of the stainless steels has shown considerable progress. Mr. David also drew attention to the welding of nonferrous metals—copper, brasses, bronzes, nickel, monel, aluminum and others as well as numerous newly developed alloys. Continuing, he made reference to metal spraying which is rapidly finding wider use and new applications, as also is the employment of hard-facing materials.



The frame of this folding machine is made up entirely of torch cut parts

In connection with the subject of torch cut parts, James Grant discussed the advancement this process had made in the railroad industry. Rods and levers can be cut so accurately in shape cutting devices that little more machine work is necessary than drilling and reaming out the holes for pins and bushings. Locomotive draw bars and safety bars are manufactured by this torch cut procedure. The shop simply forges the shanks with two square ends, after which a shaping machine profiles the forging to the proper shape and cuts out holes for the

draw bar pins. This formerly was about a five-hour machine job.

To disseminate information on the effect of flame cutting on steel, the oxyacetylene committee has compiled a report that contains data of interest to designers. It sets forth that for some reason the flame cut edge has at times been regarded with suspicion where certain applications of stress are to be made, such as mechanical calking, holes in which tubes are to be rolled or rivets driven, and where fusion welding is to be applied. It is doubtful, the committee states, whether there is any very definite reason for this suspicion and it is believed by some to be due to an unfortunate use of terms wherein this process has been referred to as a "burning" operation.

There are, however, no data to show that a clean smooth flame cut is detrimental, as long as the steel contains less than 0.35 per cent of carbon and is of the non-alloy variety. In fact, it can be said that a clean smooth flame cut edge of a medium or low carbon plate or forging has physical properties that are advantageous for certain of those purposes.

Grain Structure Changed

Considerable data have accumulated within recent years on the actual physical characteristics of the edge or face of the steel after the cutting flame has passed over it. In the case of a properly-made machine cut, the cut surface does not retain enough heat from the cutting flame to show an appreciable red color after the flame passes. Heating effect lasts for a brief time and the chilling effect of the mass of metal adjacent to the cut edge naturally is very rapid. The result is a change in the grain structure adjacent to the cut edge or kerf; the pearlite is changed to sorbite or a slightly harder form of pearlite for a depth of about 1/16 to 3/8 inch, depending on the thickness, etc.

Approves Flame Cutting

A recent investigation of the conditions which develop when the fusion welding process is applied to a flame cut edge has led the A.S.M.E. boiler code committee to remove all restrictions in its code pertaining to welding on surfaces so prepared. It now is stated in these rules that plates may be cut to size and shape by a flame cutting process if the carbon content of the material does not exceed 0.35 per cent. These rules stipulate, however, that if the plate edges are shaped by flame cutting, they must be uniform and smooth and must be freed of all loose scale and slag accumulations. It is expressly brought out by the committee that the discoloration which may remain on the flame cut surface is not considered to be detrimental oxidation.

Welding and cutting of high chromium steels was another topic in the technical program that merits discussion. In presenting data on this subject W. J. Priestley, vice president, Electro Metallurgical Co., New York, explained that chromium at high temperatures has a marked affinity for both oxygen and carbon, which makes flame control in welding exceedingly important.

Prevent Air-Hardening

Early experience with welding 4 to 7 per cent chromium steels indicated that these materials were air-hardening, with the result that the weld metal and particularly the zone adjacent to the weld became hardened. Since this property was known to be due to the presence of chromium carbide an extensive investigation was made to find other elements, with a marked affinity for carbon, which would "lock up" that troublesome element in a form that would make it unharmful. The two semi-rare elements columbium and titanium were found particularly effective for this purpose. Addition of columbium or titanium to the 4 to 7 per cent chromium steels prevents air-hardening, and greater ductility is obtained even in the as-rolled condition.

Color—A Review of Three Notable Monographs

(*Concluded from Page* 26)

and contrast the smaller areas with colors of high value and strong chroma."

In order to designate value, Munsell considered a pole passing through the center of a circle and perpendicular to it. On this pole he laid off graduations from black to white. The gray steps on this axis were arrived at by experimental work on equal visual brightness differences. This was best expressed by a decimal notation in which the absolute black was zero, and absolute white, ten. Nine steps between were defined and this range of grays was numbered as value steps, one to nine.

To cite an example of value change, the same gray appears lighter against black and darker when contrasted with white. As for chroma change, a green undergoes decided chroma change, appearing stronger on gray and grayer against a strong green.

This series of monographs costs $10.00 per set of three books. Each contains about twenty-four pages, profusely illustrated in colors.

New Machines Indicate Design Trends

MATERIALS are one of the most important factors in the design of every machine. Designers constantly demand better materials, and the metallurgist and chemist are answering that demand. The newer machines are making wider use of the high tensile, low alloy sheets which enable a reduction in weight, of the synthetic rubber which can be used in contact with oil, and of many other new materials. Designers do not make changes just for the sake of the change. When we see these new materials applied to machinery, it is an indication they have proved their worth and are qualified for future consideration on still other machines.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Construction

Truck Mixer, Concrete Transport Mixer Co., St. Louis.

Roofing Tile Cutter, Manufacturers Equipment Co., Dayton, O.

Domestic

Washing Machine, Meadows Corp., Chicago.

Vacuum Cleaner, Hoover Co., North Canton, O.

Foundry

Sand Separator and Blender, Royer Foundry & Machine Co., Kingston, Pa.

Vibrating Riddle, Vibro Mfg. Co., Chicago.

Industrial

Elevator Truck, Elwell-Parker Electric Co., Cleveland.

Electric Tools, Chicago Pneumatic Tool Co., New York.

Bench Scale, Kron Co., Bridgeport, Conn.

Electric Tools, Rotor Air Tool Co., Cleveland.

High Speed Hoist, Wright Mfg. division of American Chain Co., Inc., Bridgeport, Conn.

Metalworking

Geared Head Engine Lathe, Springfield Machine Tool Co., Springfield, O.

Bench and Pedestal Grinders, Baldor Electric Co., St. Louis.

Bench Lathe, South Bend Lathe Works, South Bend, Ind.

Hydraulic Metal Cutting Machine, Racine Tool & Machine Co., Racine, Wis.

Hole Saw, E. C. Atkins & Co., Indianapolis.

Flanging Machine, Blue Valley Machine & Mfg. Co., Kansas City, Mo.

Polishing Lathes, Hammond Machinery Builders Inc., Kalamazoo, Mich.

Office

Electric Adding Machine, Remington Rand Inc., Buffalo, N. Y.

Packaging

Wire Tying Machine, Gerrard Co. Inc., Chicago.

Screw Capper, Scientific Filter Co., New York.

Power Boating

Outboard Motors, Johnson Motor Co., Waukegan, Ill.

Printing

Mat Forming Machine, American Publishers Supply Co., West Lynn, Mass.

Proof Press, Vandercook & Sons Inc., Chicago.

Textile

Sheet Packing and Finishing Press, Prosperity Co. Inc., Syracuse, N. Y.

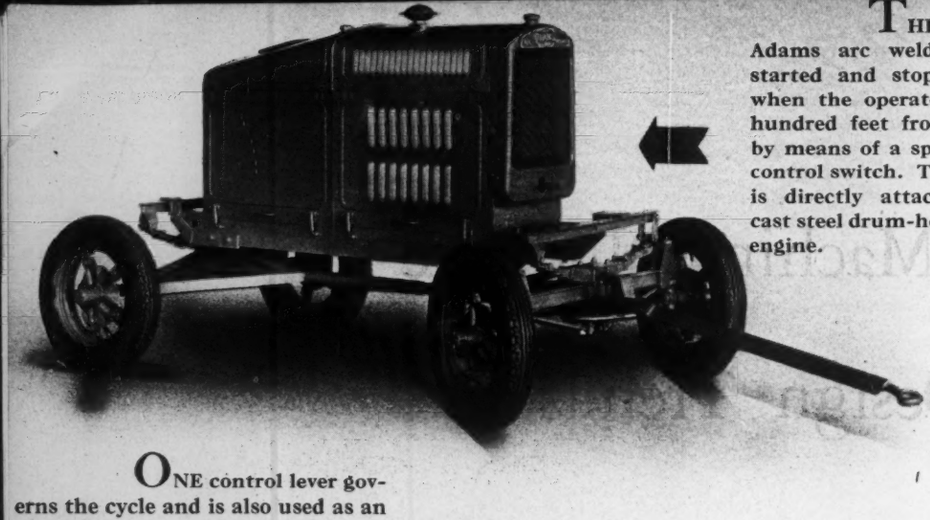
Fabric Conditioning Machine, Van Vlaanderen Machine Co., Paterson, N. J.

Welding

Direct Current Welder, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

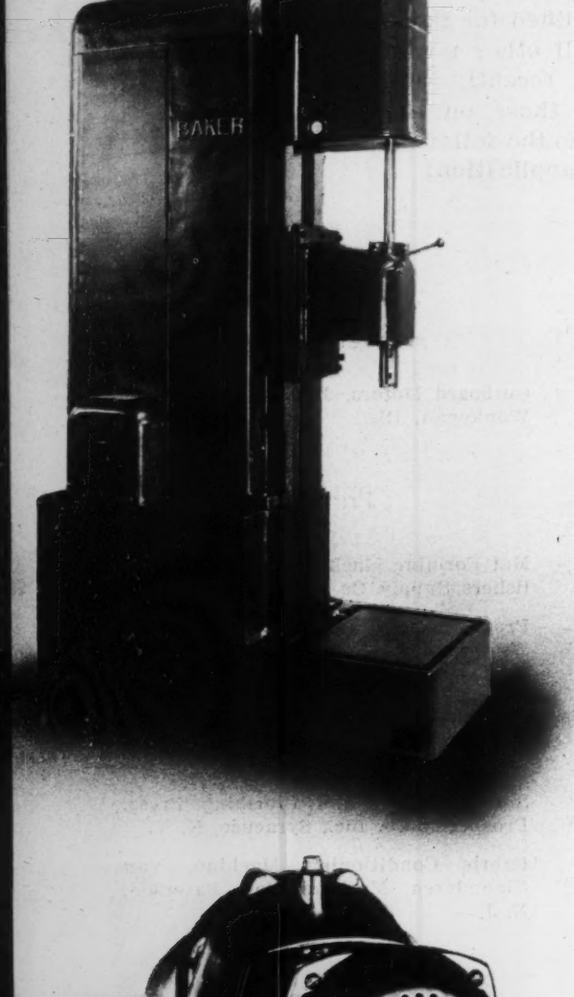
Woodworking

Planing Mill Machine, Parks Woodworking Machine Co., Cincinnati.



THE engine on Adams arc welder may be started and stopped at will when the operator is several hundred feet from the work by means of a special remote control switch. The generator is directly attached to the cast steel drum-housing of the engine.

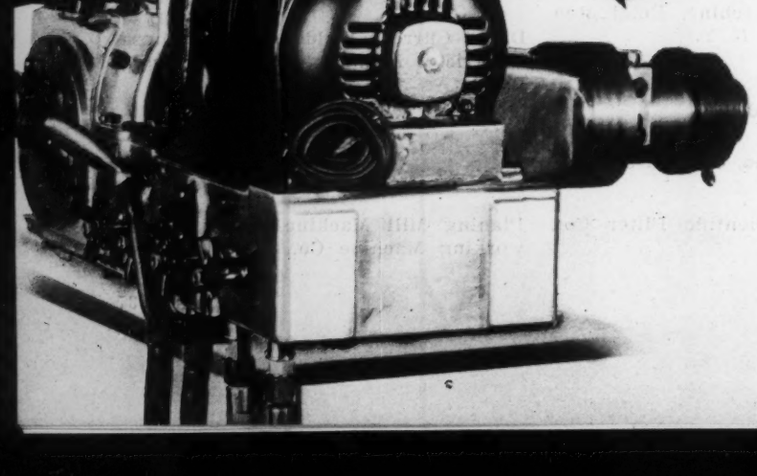
ONE control lever governs the cycle and is also used as an emergency return in Baker hydraulic feed drilling machine. This unit has exceptionally clean lines, aided by the adoption of hollow-head screws.

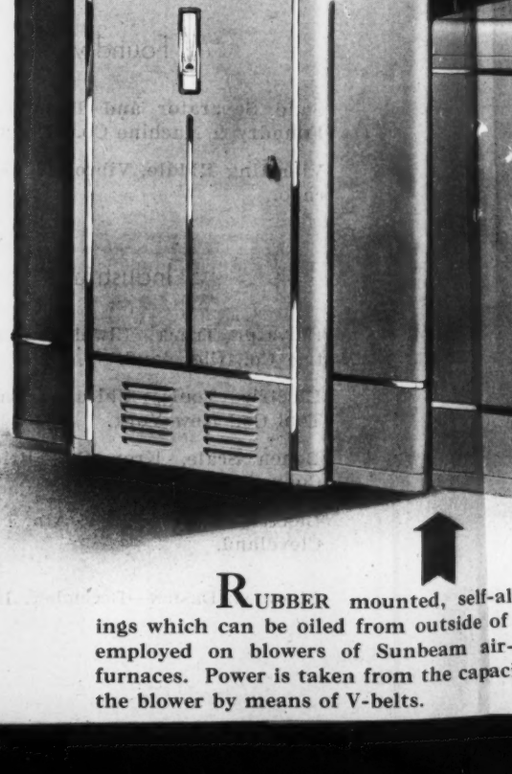


Design Features in New Machines

A Pictorial Presentation of Recent Machinery from the Standpoint of Design.

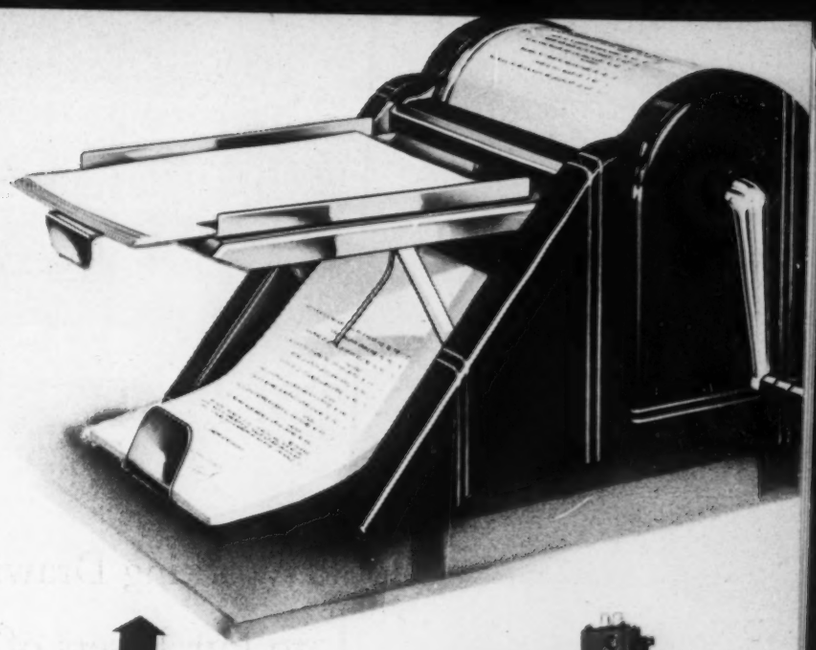
WIRE is fed through a guide to knurled feed rolls driven by an electric motor on Gillord metal spray machine. Gases and air are all handled through a dual set of valves. The machine is aluminum, lacquered with a clear lacquer.



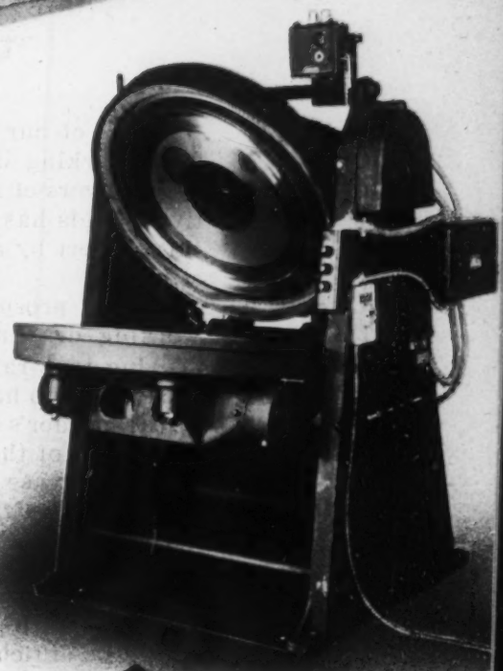


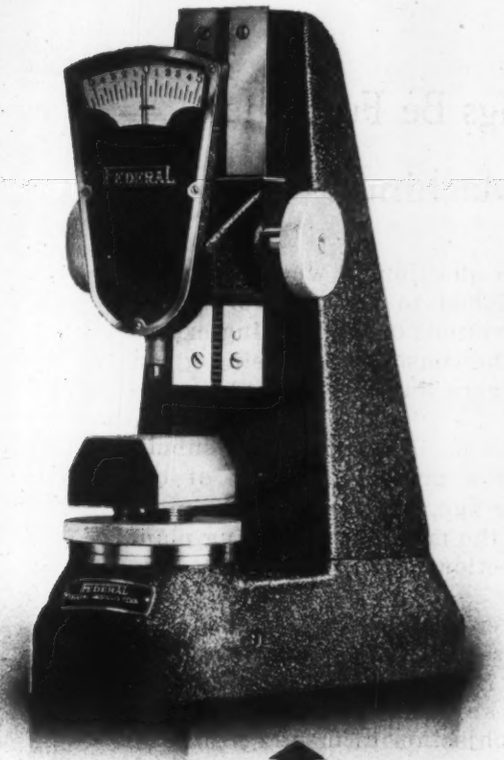
RUBBER mounted, self-al
ings which can be oiled from outside of
employed on blowers of Sunbeam air-
furnaces. Power is taken from the capac
the blower by means of V-belts.

COMPACT design of Barrett figuring machine, which is half the size of letter paper, is advanced by elimination of handle return mechanism. This design aids operation as it permits the employment of a touch system. Case is a phenolic resinoid while gears and levers are precision stampings.



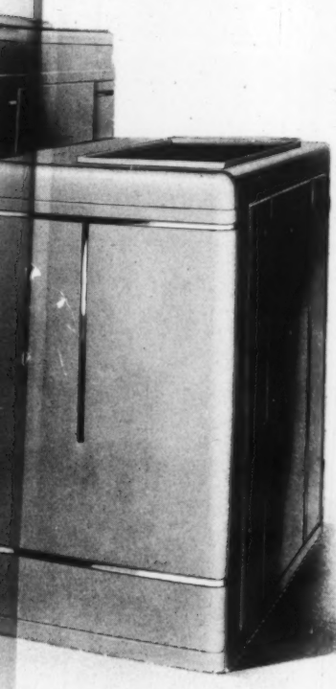
OILLESS bearings are employed to overcome the lubrication problem on new Ditto rotary duplicator. Simplicity is the keynote of the mechanism while appearance has been developed to indicate the machine functions by Willis Ahlborn Kropp.



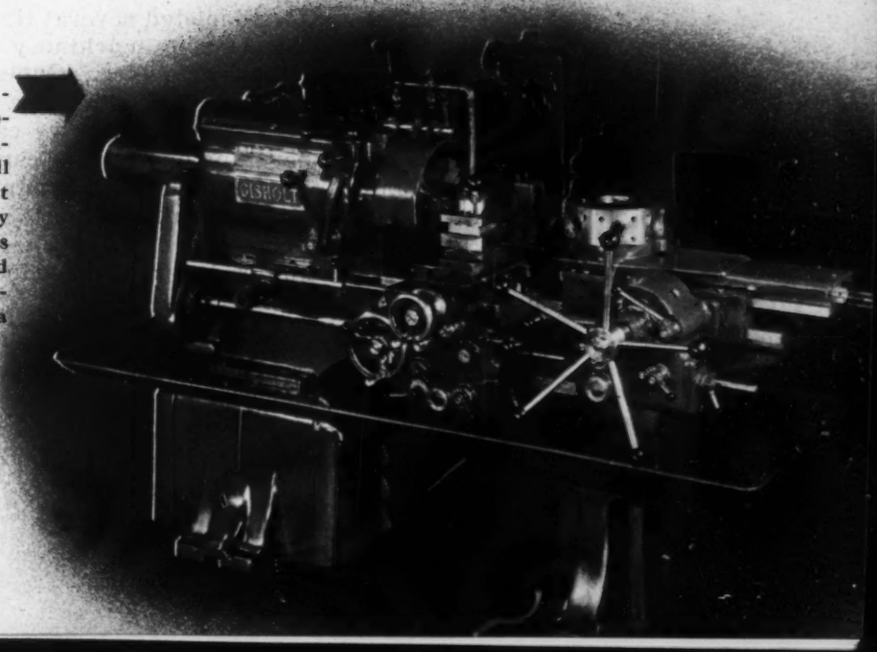


A LARGE diameter ring which bears upon ball bearings raises and lowers the lower anvil in Federal comparator. Extreme rigidity is a necessity because of the minuteness of the measurements.

AN automatic timer on National bicycle tire press controls the performance of the various mechanisms during cure. A motor, built on to the back of the machine provides the power.



BACK movement of the ram slide automatically indexes the hexagon turret and its stop roll on Gisholt ram type turret lathes. Oil is continually supplied by splash systems or hand pumps. The tapered roller spindle bearings receive lubrication from a catch reservoir.



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MACHINE DESIGN

Should Working Drawings Be Furnished to Purchasers of Machines?

ONE of our oldest controversies—the question of whether or not working drawings should be furnished to potential or actual buyers of machines—is again in the minds of engineering executives. This has been brought about by the consideration being given this subject by a committee of the Machinery and Allied Products Institute.

To a prospective purchaser there seems little reason to submit working drawings—particularly as such a prospect may be of the copying type rampant abroad some years ago. It might be far more economical to have potential buyers visit the machinery building plant at the builder's expense for a visual inspection of drawings and a demonstration of the machine in operation.

In the case of an actual buyer, however, no difficulties should arise from the furnishing of assembly or subassembly drawings, or even of certain of the detailed working drawings. Nothing remains under cover for long, and while we do not advocate any complete distribution of detail drawings, we cannot see a valid objection to meeting the customer by furnishing such drawings as may be deemed essential. It would be difficult to establish an absolutely inflexible rule.

Bull's-Eye Vision!

LIGHT-CONSCIOUSNESS is growing by leaps and bounds, primarily as a result of numerous lighting and better vision campaigns that have been staged during the past few years. Pursued to a point bordering on irritation, these campaigns fortunately eased off just in time to bring to their sponsors a maximum of effectiveness.

One of the results, as depicted several times recently in MACHINE DESIGN, has been the adoption by machinery manufacturers of lighting systems built into their machines. Gone, or going, are the days when an operator will be compelled to use a portable light tied with string on his machine—often with a wire cage protecting the lamp bulb and a piece of paper hung on or in the cage to reduce glare!

With the intensification of modern production and the closer tolerances involved, the designer who neglects all consideration of adequate lighting jeopardizes his company's name. Machine operation, though approaching hundred per cent perfection, still can't be performed in the dark!

ditorial

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Eliminating Speed Variations

To the Editor:

I WAS much interested in the letter of W. E. Hale in your October issue. This letter on "pulsations in chain-conveyors," etc. brought out a point too often neglected. As Mr. Hale indicated, it is desirable to so select idler sprockets that the angle of chain-wrap includes a whole number of teeth. It should also be stated that "traction-wheels," if used, should follow the same rule. Of course this rule is only meant to apply to wheels having less than ten teeth, or an equivalent diameter.

There is another rule of equal importance: The center-to-center distance of sprockets should contain a whole number of chain pitches.

It is not always possible to follow both of these rules but it is very important that both are not violated in the same instance.

Rules Are Varified By Experience

Each of the foregoing rules has mathematical basis and has been amply verified by experience. The writer has knowledge of actual trouble caused in several instances by lack of attention to them.

Mr. Hale stated that independent pulsations can be introduced by idler sprockets but did not bring out the fact that these pulsations are actually more serious than those caused by the driver. In fact, we may neglect pulsations caused by the driver if we pay proper attention to the foregoing principles.

The mathematical theory involved is very interesting but a little too long to give in a letter. Suffice to say, a six-tooth driving sprocket (a somewhat extreme case) would cause an overall variation in tangential section of chain approaching same of 13.9 per cent, whereas the same sprocket (or equivalent traction-wheel) would introduce an overall variation of 28.9 per cent if used as an idler at a 90-degree corner. On one hand, the same idler at a 60-degree turn, or an eight-tooth wheel at the 90-degree turn would avoid causing pulsation. On the other hand if the next 90-degree corner is a whole member of chain pitches away, one pulsation will be cancelled at the next turn so that the following tangent will have no pulsation except the original one introduced by the driver.

The writer knows of one continuous-duty job having an idler-wheel pulsation in which the motor shaft finally crystallized and broke; and another job in which several pulsations were imposed one upon the other so that the chain actually pulled in two. This last job was especially regrettable in that moving one short vertical section one foot would have cancelled two pulsations.

The increased pulsation caused by the idlers derives from the fact that in any case, speed of chain "entering" the sprocket depends upon the speed of the sprocket itself; driver turns at uniform speed but speed of idler is intermittent itself, giving for the case in question a double increase as successive chords of pitch-polygon become tangent to the "leaving" section of the chain, and a double decrease as they become tangent to the "entering" section. The subject is very interesting and the problem bobs up occasionally in trolly conveyors having "dips" and "rises."

—CHESMAN A. LEE, *Mech. Engr.*
Darling & Co.

When Is an Idea New?

To the Editor:

YOUR remarks on streamlined trains, page 46 of your issue of July, 1935, applies almost equally well to self-laying or caterpillar tracks and you may, therefore, be interested in the following extract from the writer's *Excavating Machinery* published by Ernest Benn, Ltd.

"It is the general belief that the self-laying track is a new idea. On the contrary, it is one of those things which evoke the old saying, "There is nothing new under the sun," as their application to vehicles is covered by some of the earliest patents in the British Patent Office, actually as far back as 1691 A.D., when Patent No. 277 was granted to Kendrick Edisbury in this quaint old English:

" 'William and Mary, by the Grace of God to

whom these Presents shall come greeting.

"'Whereas Kendrick Edisbury hath by his humble peticon represented unto us that with great charges and much time spent he hath invented and found out:

"'*A new art or invention of certaine rollers to be used under the bodies of carriages, carts and waggons instead of wheels by amending and preserving as well the highways as private grounds* which said invention was never used in England before and prayed us to grant him our Letters Patents for the sole use thereof, for the term of fourteen years.'

"Although some of the early patents along the lines of this one were not specific, it is evident that the inventors realized the advantages and claims of our present-day self-laying tracks, and provided an endless chain of rollers to bear on the ground in place of the usual wheels."

—W. BARNES,
Lincoln England

Gives Weights of Bar Stock

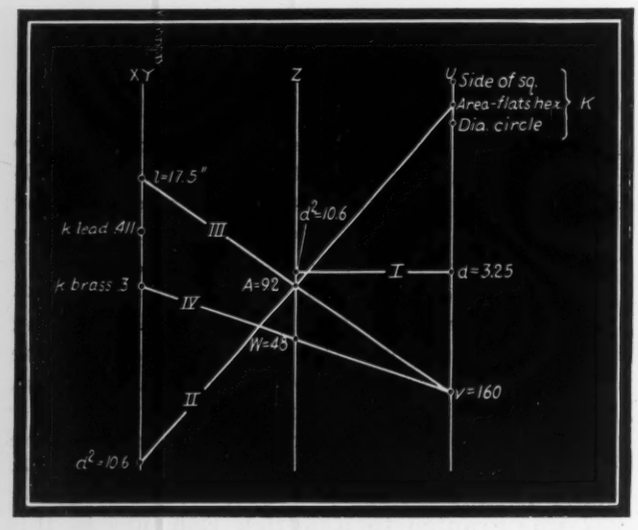
To the Editor:

IN CONNECTION with the article "Universal Nomogram Eliminates Needless Work," published in the November issue of MACHINE DESIGN, I would like to offer the accompanying figure which shows how to compute the weight in pounds of round, hex or square bar stock, when the material, its shape and length are given, by drawing four secants in the order shown. This figure is based on the nomogram on page 30 of your November issue.

The shape constant K on the U scale is 1 for the side of square stock, 0.866 for the diameter across the flats for hex, and 0.785 for diameter of round stock. The Y scale is used only for l, the length in inches. The weight constants k for the different materials should be marked on the X scale for the materials most used. Some values of k, the weight in pounds per cubic inch, are:

Cast iron 0.26, steel, 0.283, copper, 0.318, brass 0.3, lead 0.411, aluminum 0.096.

The weight of a hex brass bar 3.25 inches across the flats 17.5 inches long is 48 pounds, by secants I, II, III, IV. Its cross-sectional area is 9.2 square inches, by secants, I, II. Its volume is 160 cu. in., by secants II, III.



Nomogram simplifies computation of the weight in pounds of round, hex or square bar stock

—CARL P. NACHOD, *vice president,*
Nachod & U. S. Signal Co.

Do Engineers Lack Proper Training?

To the Editor:

IN DISCUSSIONS with a number of friends the subject of late has turned frequently to engineers and their training. As I am a graduate engineer, the trend of these discussion has been rather disturbing to me. The reason is that a great many men engaged in other professions and in other work have expressed some not altogether complimentary opinions.

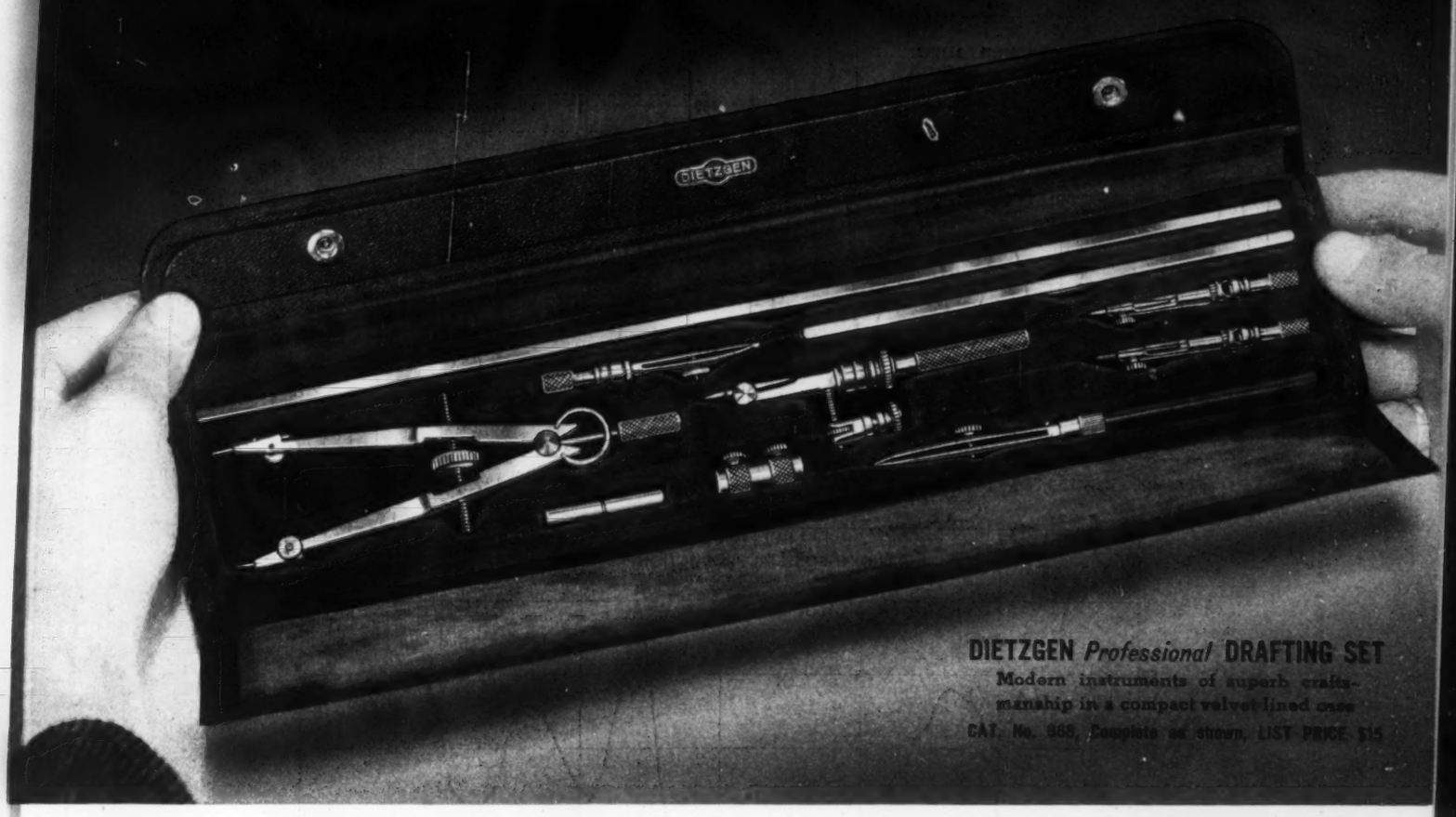
In general, the trend of the thoughts has seemed to be that there are a number of phases in general education which the engineering curriculum overlooks entirely, and that these phases are of vital importance to all persons engaged in industry. The courses mentioned most frequently as being of possible value to engineers, and courses which they do not usually take, are required study in public speaking, salesmanship, and business administration. Not theoretical economics, but a practical business training course.

From experience, I know that it would be difficult to add much more to the load carried by the average engineering student, but the arguments for the courses mentioned in the foregoing have been very substantial, and, if proved might make it worth while to eliminate one or more of the general courses now carried and substitute one of those mentioned. We all recognize that public speaking is valuable to everyone. Salesmanship is also said to be of value, as every man has something to sell whether it is ideas or hosiery, and the engineer is no exception. Business administration, it is claimed, would prevent the engineer from falling into many of the traps he is now subjected to.

Perhaps your readers have some ideas along these lines. Would it be possible for you to offer them the opportunity of expressing their opinions?

—ALBERT FOSTER,
Chicago.

YOU DESIGNED THIS SET
. . . YOU MUST NEED IT!



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Modern instruments of superb craftsmanship in a compact velvet lined case
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☆ Men who earn their living at a drawing board . . . engineers, draftsmen, designers, architects, artists . . . wrote the specifications for this newest Dietzgen set. Not just another drawing set—but a master set for professional men—a set to do correctly the unusual as well as the regular jobs of everyday drafting. Regardless of the instruments in your kit today, *this* set has immediate appeal. ☆ Its man-sized Bow Pencil with center wheel adjustment is rigid and positive. Pick it up and put it down a dozen times . . . its adjustment never varies. Its range of 8 inches covers 80% of all circles drawn. ☆ Then the micro-adjustable Beam Compass draws circles *perfectly* over 3 *feet* in diameter. ☆ And the marvelous balance of the new streamlined Master Ruling Pen is a story only use can tell adequately. ☆ You, too, will say this Dietzgen *Professional* Set is the greatest buy you've ever made.

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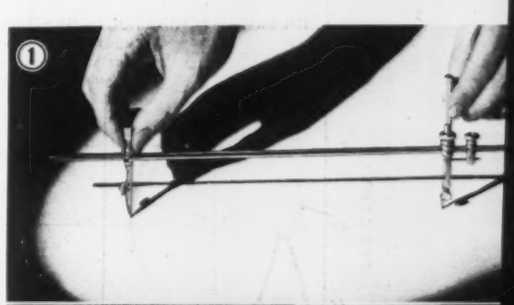
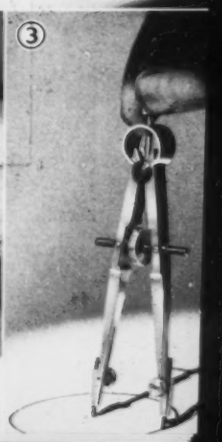
DIETZGEN

World Famous Quality



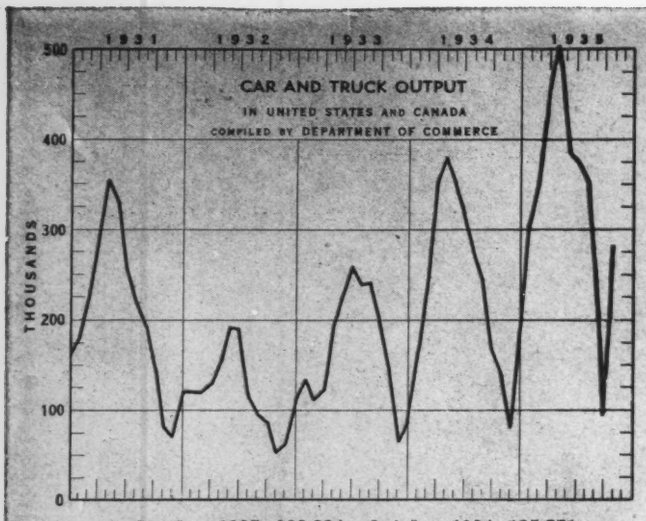
(1) Beam Compass may be used as dividers or to draw circles up to 37.5 inch diameter in pencil or in ink.

(2) The streamlined Master Ruling Pen has unusual ink capacity coupled with feather-touch balanced design.

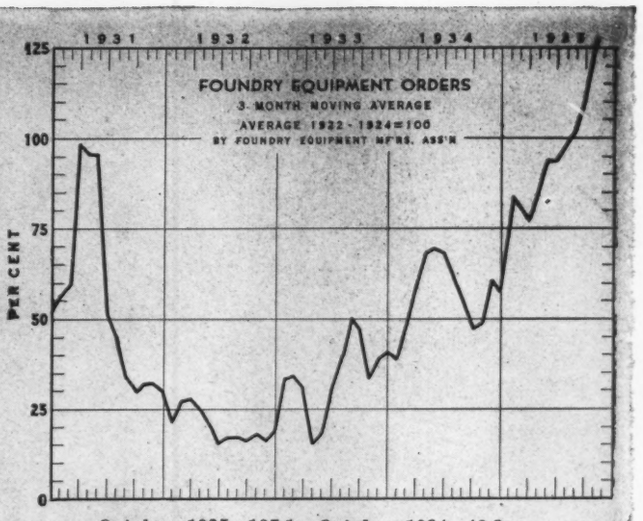


(3) 80% of all circles drawn on commercial boards fall within the 8 inch range of this superfast, rigid Master Bow Pencil.

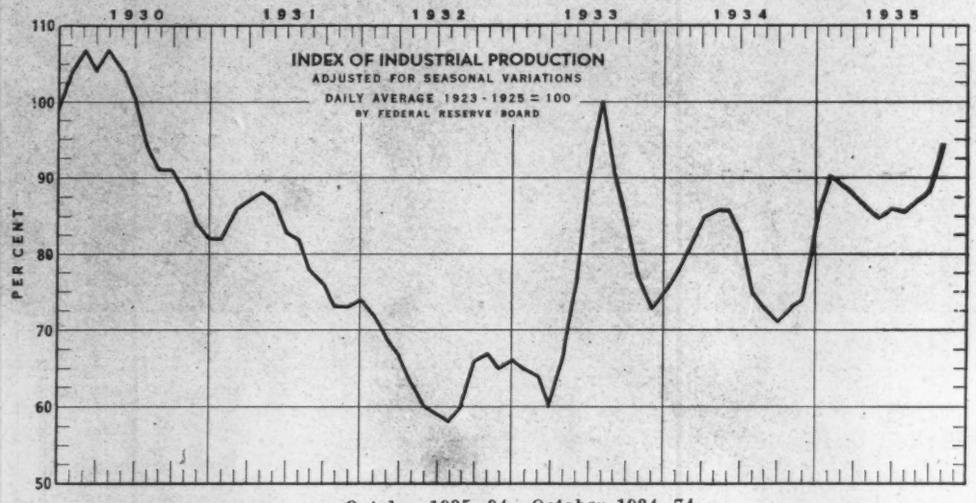
How is Business?



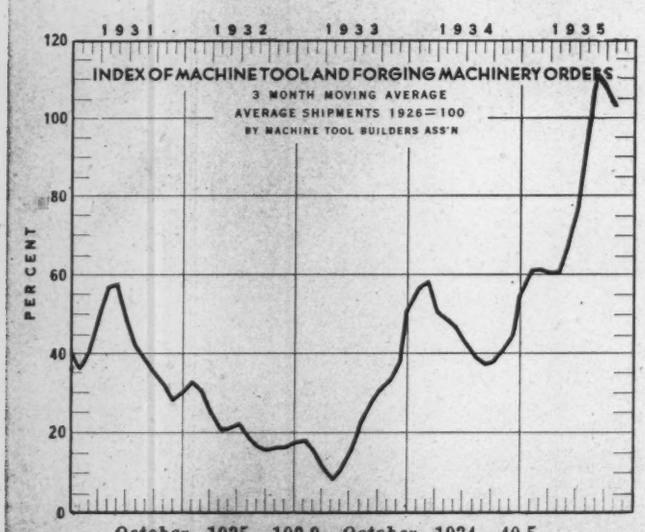
October 1935, 283,334—*October* 1934, 135,771



October 1935, 127.1—*October* 1934, 48.3



October 1935, 94—*October* 1934, 74

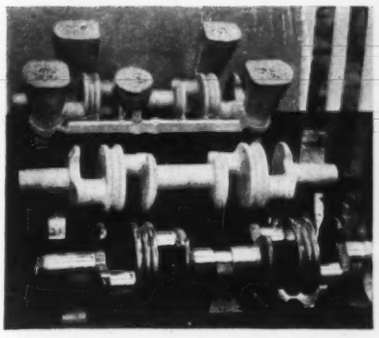


October 1935, 102.9—*October* 1934, 40.5

October 1935, 83.7—*October* 1934, 76.8

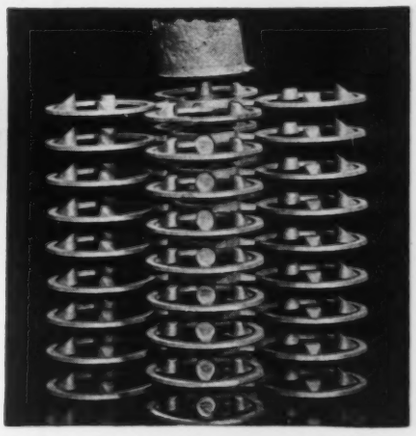
Nickel Alloys get the call for Vital Parts in Caterpillar Diesels

● All five sizes of Caterpillar Diesels, ranging from 130 to 47 B.H.P. are equipped with Nickel Cast Iron engine heads, cylinder liners, starting motor crankshafts, piston rings and valve lifters. The use of this strong, tough, hard Nickel Alloyed Iron is steadily becoming standard in all automotive applications requiring high resistance to heat, pressure, fatigue and wear. Nickel Alloy Steels are also liberally used for various Caterpillar parts subjected to unusual stress and shock.



● Starting engine crankshafts of Nickel-molybdenum Cast Iron. Top to bottom—(1) Casting as it comes from the mold. (2) Risers and skim gates removed. (3) Ready for installation. Outstanding properties of these crankshafts are high strength and hardness, improved toughness and resistance to fatigue. Economy is also obtained by casting to size, reducing machining costs as compared with forgings.

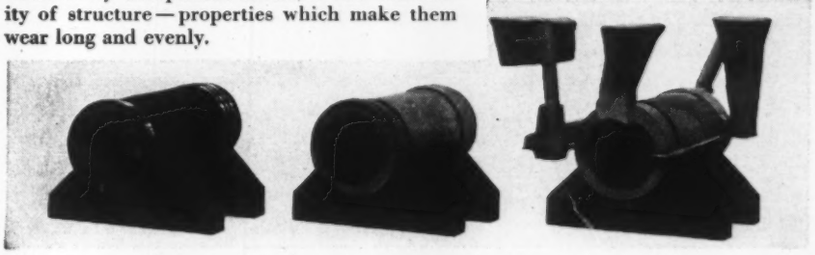
CAST IRONS
NICKEL
ALLOY STEELS



● "Tree" of Nickel-chromium molybdenum Cast Iron piston rings as it came from foundry mold. These rings are heat treated to possess high strength and hardness, improved toughness and resistance to impact, giving a ring that is notable for long wear.

Our casting specialists and engineers will be glad to consult with you and to recommend suitable applications and compositions of Nickel Irons and Nickel Steels.

● Nickel-chromium Cast Iron cylinder liners showing three steps of production. Right to left—(1) Rough casting before removal of skim gates, risers and shrink heads. (2) Ready for machine shop. (3) Finished liner after heat treatment. These liners are featured by exceptional hardness and uniformity of structure—properties which make them wear long and evenly.



THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

MEN of MACHINES

J. L. WICK JR.

NOW vice president of the American Foundrymen's association is J. L. Wick Jr. He was elected to this office recently to fill the vacancy occasioned by the death of B. H. Johnson. Mr. Wick, who in business life heads the Falcon Bronze Co., Youngstown, O., has been active in the association for many years.

Born in Youngstown in 1883, he received his technical training at Massachusetts Institute of Technology. In 1906 he was graduated with a degree in mechanical engineering.

His company affiliations during ensuing years included Youngstown Sheet & Tube Co., Natural Light & Thorium Co., and Crystal Ice & Storage Co. In 1919 he became connected with the Falcon company, rising to his present position as president and general manager in 1925.

• • •

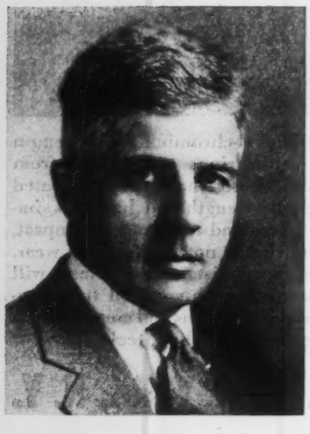
CHARLES F. SCOTT

WORD comes that Charles F. Scott is the new chairman of the Engineers' Council for Professional Development, the conference of engineering bodies organized to enhance the professional status of the engineer. He is professor emeritus of electrical engineering, Yale university.

MACHINE DESIGN, Jan., 1930, contained a biographical sketch of Dr. Scott. He rose to prominence in the Westinghouse Electric & Mfg. Co. during his term of service from 1888 to 1911, leaving a record that has since been embellished by his career at Yale.

Active in the E. C. P. D. since its inception three years ago, Dr. Scott has been on the executive committee as well as A. I. E. E. representative. He was instrumental in securing funds for the construction of the Engineering Societies Building in New York.

• • •



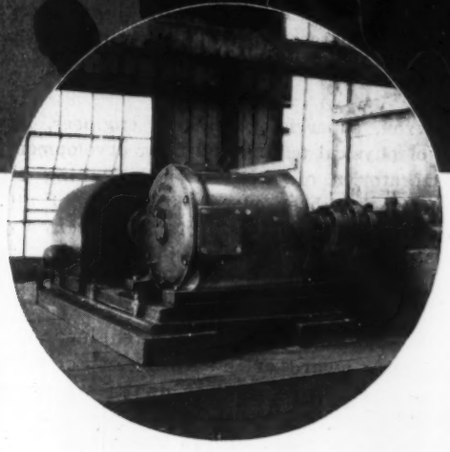
THEO. BROWN

THIS year the Cyrus Hall McCormick gold medal was awarded to Theo. Brown. This honor is conferred annually by the American Society of Agricultural Engineers for outstanding scientific achievement in engineering as applied to agriculture.

Born in Worcester, Mass., Mr. Brown was graduated in 1901 from the Polytechnic Institute located there. Two years later he received his first patent, the beginning of a notable career in mechanical invention. In 1911 he joined Deere & Co. and five years later was placed in charge of experimental work. That same year, 1916, he developed a one-row motor cultivator capable also of other farm work—his initial contribution to the evolution of the general purpose tractor. When the United States entered the World war he gave largely of his time and effort to the design and

On the Map!

D.O.-JAMES



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ESTABLISHED 1888

D.O. JAMES MANUFACTURING CO. 1120 WEST MONROE STREET · CHICAGO

IN designing parts to be turned out on a quantity-production basis, it is well worth while to view them in the light of bar-mill capabilities. Often it happens that the design can be adapted to manufacture from special rolled sections.

Bethlehem pioneered this type of steel product and has rolled a wide variety of difficult sections. If a section can possibly be rolled, it can be rolled in the Bethlehem Bar Mills.

So great are the savings sometimes realized by the use of special rolled sections that we suggest a careful review of the parts of your product with an eye to this economical method of manufacture.

BETHLEHEM STEEL

Bethlehem Steel Company

General Offices: Bethlehem, Pa.

Bethlehem District Offices are located at Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Houston, Indianapolis, Kansas City, Milwaukee, New York, Philadelphia, Pittsburgh, San Antonio, St. Louis, St. Paul, Washington, Wilkes-Barre, York. *Pacific Coast Distributor:* Pacific Coast Steel Corporation, San Francisco, Seattle, Los Angeles, Portland, Salt Lake City, Honolulu. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

production of a combat wagon used by the A. E. F. in France. While the number and significance of his patents rank him as an inventor of note, Mr. Brown's methods and viewpoints are essentially those of the practicing engineer. At present he is chief of implement research development in the Deere organization.

♦ ♦ ♦

C. A. McCUNE, director and secretary of the Magnaflux Corp., New York, was the recipient of the Samuel Wylie Miller medal at the recent fall meeting of the American Welding society.

♦ ♦ ♦

COL. ROGERS BIRNIE has been awarded the Ordnance Medal of Merit by the Army Ordnance association for engineering skill and invention in the development of modern armament.

♦ ♦ ♦

FRANK D. PELTIER has been appointed chief engineer of the refrigeration division of Fairbanks-Morse Home Appliances Inc. He was for seven years connected with Servel Inc., in its engineering and production departments.

♦ ♦ ♦

J. C. MARTIN JR. has been made president of the Metalspray Co. Inc., Los Angeles. He has been active in various engineering fields, serving as a consulting engineer and patent council for several major industries.

♦ ♦ ♦

JEROME STRAUSS now is vice president in charge of research and development of the Vanadium Corp. of America, Bridgeville, Pa. He has been with the company since 1928 and is a graduate of Stevens Institute of Technology.

♦ ♦ ♦

R. L. KENYON, supervising research engineer, in charge of methods of physical testing and their development in the research laboratories of the American Rolling Mill Co., Middletown, O., has been placed in charge of all metallurgical work in the development of the company's wrought steel wheels.

* * *

S. J. MIKINA, Wesinghouse research engineer, is recipient of the junior award of the American Society of Mechanical Engineers. The subject of his paper for which the honor was bestowed, was entitled, "Effect of Skewing and Pole Spacing on Magnetic Noise in Electrical Machinery."

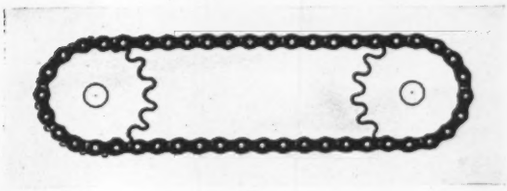
♦ ♦ ♦

H. M. NORTHRUP recently was made chief engineer in charge of all engineering activities of Hudson Motor Car Co., Detroit. He has been assistant chief engineer since 1929, and in his new capacity will operate under the direct supervision of Vice President S. G. BAITS, for many years Hudson's chief engineer.

* * *

FRANK J. TONE, president of the Carborundum Co., Niagara Falls, N. Y., recently was awarded the Edward Goodrich Acheson medal and prize of $1000 at the meeting of the Electrochemical Society in Washington. The

Some of the Things You Can Do Better with DIAMOND CHAIN



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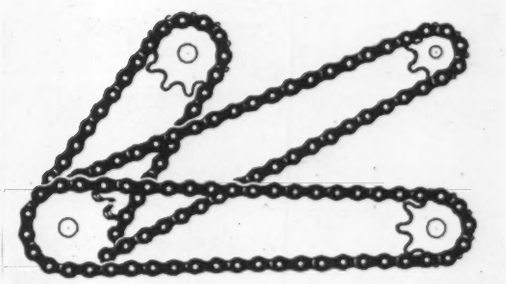

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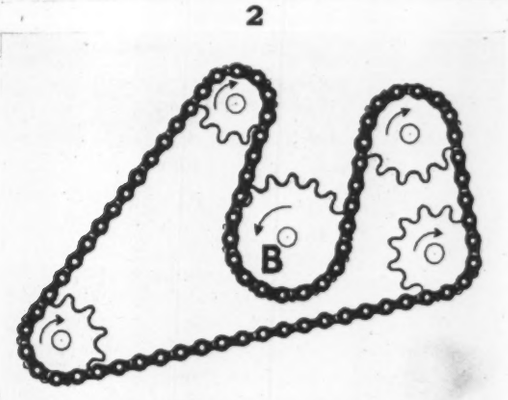

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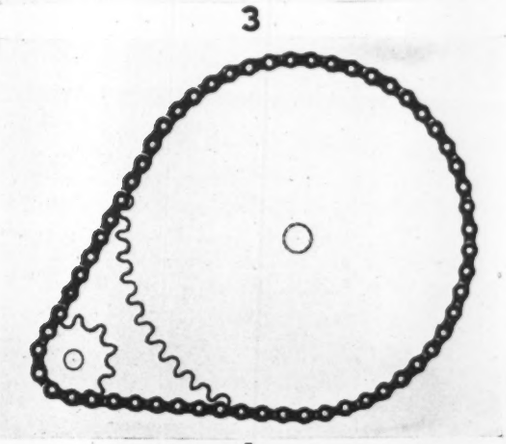


4

1 From Shaft to Shaft

A simple connection from one shaft to another—heavy single or multiple strand large pitch chains for relatively slow speeds and heavy loads—lighter single or multiple chains of shorter pitch for lighter loads—or high speeds. Shafts can be at any distance apart and ratio of speeds of shafts will remain constant because there is *no* slipping.

2 One Shaft to Several

A main driving shaft in a machine may drive a number of other shafts by putting as many sprockets on the driving shaft as there are other sprockets to drive. Speeds of driven shafts can be whatever is required and these speed ratios will be constantly maintained.

3 Another Shaft Group Arrangement

Another way of driving a group is shown here—one wheel (B) is being made to run in a direction opposite to the others. Different speeds are attained by selection of sprockets of different diameters. Diamond Roller Chain can be run on either side—note at sprocket B.

4 Large Speed Ratios No Problem

The non-slip feature of Diamond Chain is always an advantage—but it is doubly so on those drives where there is a big sprocket and a very little one—with short center distance. Many motor drives have large ratios, and a positive drive like Diamond is essential to satisfactory operation and constant production.

5 Easy Installation and Replacement

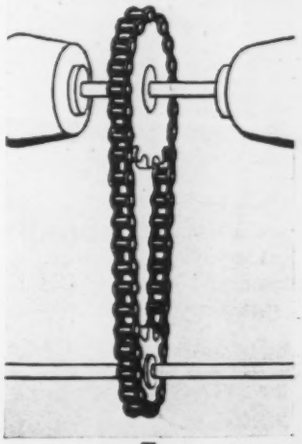
Where drive is placed on shaft between bearings (not outboard) there is no difficulty—chain may be put on or removed without dismantling. The length of chain is wrapped around and joined by a detachable connecting link.

And—Less Width Per Horsepower

Present day designs of motor driven machinery take advantage also of the fact that Diamond Motor Drives take up less space along the shaft to transmit a given horsepower—making a more compact arrangement.

• • •

Recommendations based on tens of thousands of applications is yours for the asking. Catalog 583 also mailed on request. DIAMOND CHAIN & MFG. CO., 435 Kentucky Avenue, Indianapolis, Ind. *Offices and Distributors in Principal Cities.*



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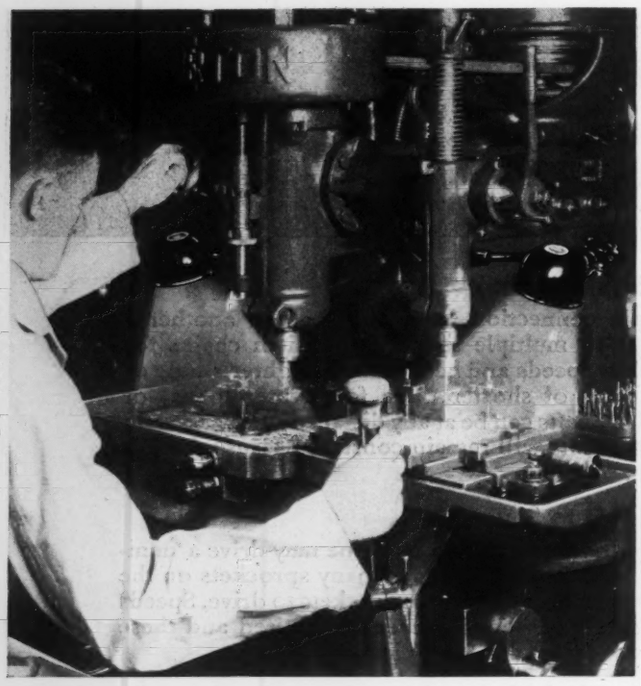
DIAMOND ROLLER CHAIN

ROLLING AT EVERY POINT OF CONTACT



PROPER LIGHTING

Helps Sell Machines

Because of the greater efficiency, economy and safety, industry everywhere, is turning to high intensity localized lighting for work requiring speed and accuracy. Such illumination has become a selling feature of increasing value to machine designers and builders.

Fostoria now offers a Machine Lamp that can be properly incorporated as regular equipment on all types of machines. Of durable, fool-proof construction, the Fostoria Machine Lamp provides maximum flexibility with sufficient rigidity to withstand the shocks and vibration of modern machine operation. All possibility of glare is eliminated by a specially designed reflector. Wear-proof ball and socket joints permit high intensity light to be focused on working surfaces from any direction as easily as pointing your finger, and as quickly pushed back out of the way.

Fostoria Machine Lamps on your machines will add little to your cost but much to your selling story. We will gladly analyze your machines and submit specific recommendations, without obligation. Write for complete information.

MACHINE fostoria LAMP

THE FOSTORIA PRESSED STEEL CORP., FOSTORIA, O.

latter amount Dr. Tone returned to the Acheson fund for use in furthering worthwhile research in electrochemistry and in electro-thermics, the field in which he has made so many worthwhile achievements.

♦ ♦ ♦

J. D. JONES recently was appointed chief engineer of Youngstown Sheet & Tube Co.

♦ ♦ ♦

NORMAN D. MACLEOD, president and general manager of Abrasive Machine Tool Co., East Providence, R. I., is the new president of the National Machine Tool Builders Association.

♦ ♦ ♦

HENRY T. HARRISON has resigned as vice president in charge of operations of Corrigan, McKinney Steel Co. He is a graduate of the University of Michigan, in mechanical and electrical engineering. About 1888 he became associated with the then Wellman-Seaver-Morgan Co., Cleveland, as engineer.

♦ ♦ ♦

WORTHY C. BUCKNAM recently received the Morehead medal for 1934 for his outstanding accomplishments in the development of oxyacetylene welding and cutting apparatus, particularly of the motor-driven type. The honor was bestowed upon him during the thirty-sixth annual convention of the International Acetylene association.

♦ ♦ ♦

C. M. DAVIS is engineer in executive charge of all engineering matters of the transportation division of General Electric, according to an announcement that all commercial and engineering activities of this department, with the exception of railroad signal equipment, has been centralized at the Erie, Pa., works.

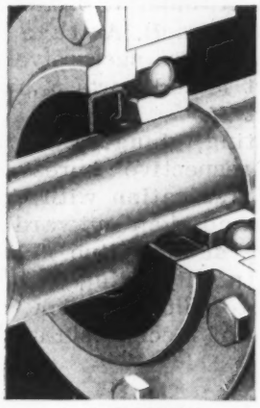
♦ ♦ ♦

DR. E. R. WEIDLEIN, director of Mellon Institute of Industrial Research at the University of Pittsburgh, received the Chemical Industry medal of the Society of Chemical Industry recently. This award was made in recognition of the valuable applications of chemical research to industry that have been carried out under his direction.

♦ ♦ ♦

GABRIEL KRON, General Electric engineer, recently received an award of 10,000 Belgian francs as first prize in a competition sponsored by the George Montefiore Foundation of the University of Liege, Belgium, for the greatest contribution to the art and science of electrical engineering during the last three years. The award was based on a memoir, "Non-Riemannian Dynamics of Rotating Electrical Machinery."

KLOZURE THE EFFECTIVE OIL SEAL



PATENTED

DENSE, grainless, resilient, tough . . . the sealing ring of the Garlock KLOZURE effectively resists oil and heat—and reduces friction to an absolute minimum.

Not leather, cork or felt—this sealing ring consists of an exclusive Garlock compound specially developed in the Garlock laboratories. It is molded to exact sizes—accurate in *every* dimension.

The Garlock KLOZURE is establishing remarkable performance records on all types of equipment. Complete range of sizes. Write for booklet.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Co. of Canada, Ltd.
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The Adapter

The Spreader

The Sealing Ring

The Case

GARLOCK

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Designed with thorough knowledge of drafting conditions, this machine entirely eliminates the separate use of triangle, T-square, scales and protractor . . . produces more accurate drawings than old-fashioned methods. Made in both standard and civil engineers' models, it demonstrates its worth in any drafting room.

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Noteworthy Patents

PATENT No. 2,015,423 covering an hydraulic pump or motor is important because it brings a new design to a rapidly growing field. Its recipient is Ralph E. Flanders, president, Jones & Lamson Machine Co., and a well-known engineer. His device is of the swash-plate type, *Fig.* 1. Surrounding a central bore is a circular series of bores *A*, open at one end to receive reciprocating plungers *B*. As cage *C* rotates about stem *D*, ports *E* are successively in communication with port *F* and ports *G* are in communication with port *H*.

When the pump is operating, plungers *B* are forced inwardly in their respective bores *A* while the bores are in communication with the discharge line of the unit, and then outwardly when connected with the suction line. This motion is effected through a tilted ring *J*, operated through a swashplate block which is controlled by a geneva type of mechanism such

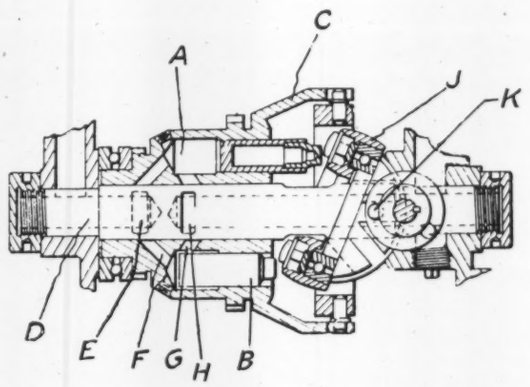
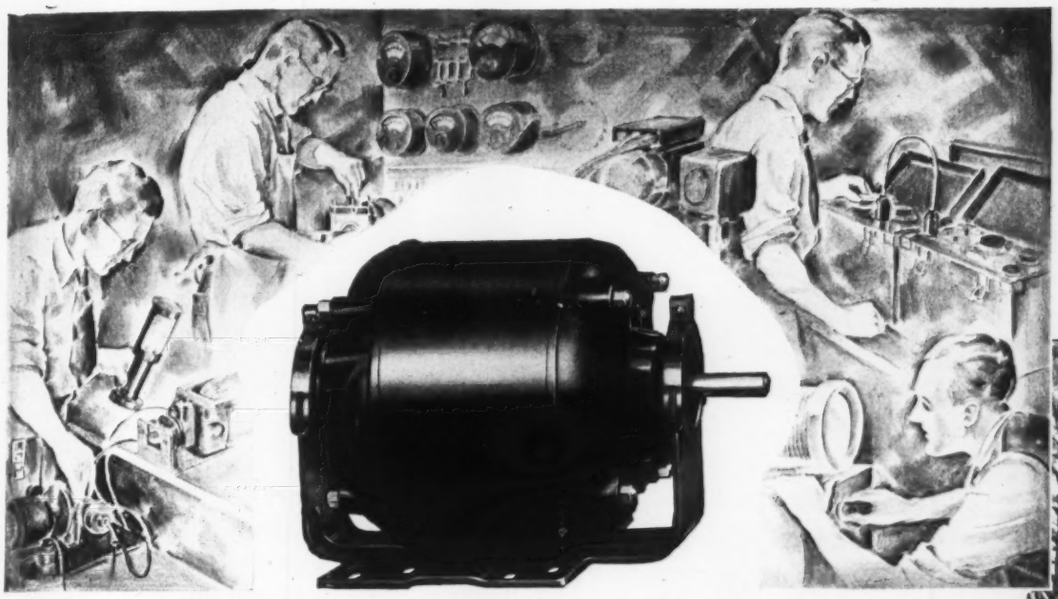


Fig. 1—A geneva type mechanism controls a swashplate in this hydraulic pump



BALANCE

For your protection demand a motor that will meet all these requirements—quietness, reputation for dependable performance, enduring service, public acceptance. In short, select a motor of BALANCED quality—BALANCED performance.

Emerson's enviable reputation as builders of balanced motors is attributable to:

1. years of patient research,
2. pioneering engineering,
3. careful selection of raw materials,
4. hundreds of tests with specially designed scientific equipment,
5. precision manufacturing methods,
6. strict adherence to exacting production standards,
7. individual tests of finished motors.

Learn more about the advantages of Emerson Motors. Write today for booklet 46-M which gives details of how Emerson achieves BALANCED motor performance.

W. G. Shelton Co., Inc. Chooses Emerson Motors for BALANCED Performance

When the W. G. Shelton Co., St. Louis, Missouri, decided to produce their new Circulator 6-point Hair Dryer, they were aware that quietness, unfailing service, and long life would be demanded of their product. Knowing that Emerson Motors possessed these inherent virtues, Shelton availed themselves of Emerson's individual engineering service and precision manufacturing facilities to secure a motor of BALANCED performance perfectly adapted to their requirements.

Visit Emerson Booths Nos. 410-509, International Heating & Ventilating Exposition, Chicago – Jan. 27-31

EMERSON MOTORS

3 HP and smaller—Single-phase—Polyphase—Direct Current

THE EMERSON ELECTRIC MFG. CO.

NEW YORK ST. LOUIS CHICAGO

LEADERS IN THE FAN AND MOTOR INDUSTRY SINCE 1890

"METRON-O-SCOPE" Power Problem SOLVED!

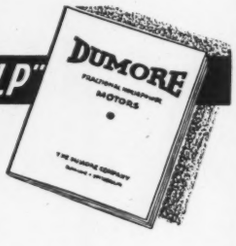
The American Optical Company, makers of "Ful-Vue" frames and other well known optical products, recently introduced the "Metron-O-Scope" — a remarkable instrument that combines the most practical and successful methods of reading training. The power requirements for this new device were unusually stringent: a motor that was quiet, dependable, smooth running, and above all, exactly controllable. The recommendations of Dumore Engineers were submitted and accepted. Thus Dumore added another to their long list of power problem solutions peculiar to the manufacture of highly specialized instruments, machinery and tools.

Dumore precision-built motors are obtainable in many sizes; in horsepower from 1/100 to 3/4; in voltages from 6 to 250; in any speed through electric governors (on 1/4 h.p. or less) and by speed reducers (on 1/6 h.p. or less). The handy Dumore catalog shows you how to obtain FREE engineering service. Use the coupon below.

DO YOU KNOW

that the Dumore Company builds a complete line of Lathe and Hand Grinders? These tools are used the world over for **precision** grinding in tool and die rooms, pattern shops and on production work.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS



APPLICATION FOR "HELP"

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Racine, Wis.

Send me your latest catalog of Dumore fractional h. p. (series wound) motors.

*Name*_____ *Title*_____

*Firm Name*_____

*Address*_____

*City*_____ *State*_____

as indicated at *K*. Hence, each plunger as it swings around the axis of the stem bears alternately against the high and low sides of ring *J*, thus forcing oil through either port *H* or port *F*. To minimize frictional resistance and wear the ring is provided with a series of rotatable buttons, mounted in ball bearings, that engage the flat end faces of the plungers.

CORRUGATED paper board is made by a machine recently patented, *Fig.* 2, in which a continuous liner web *A* is applied to the silicated tips of a corrugated web *B*. This process is effected as the latter passes around one of the

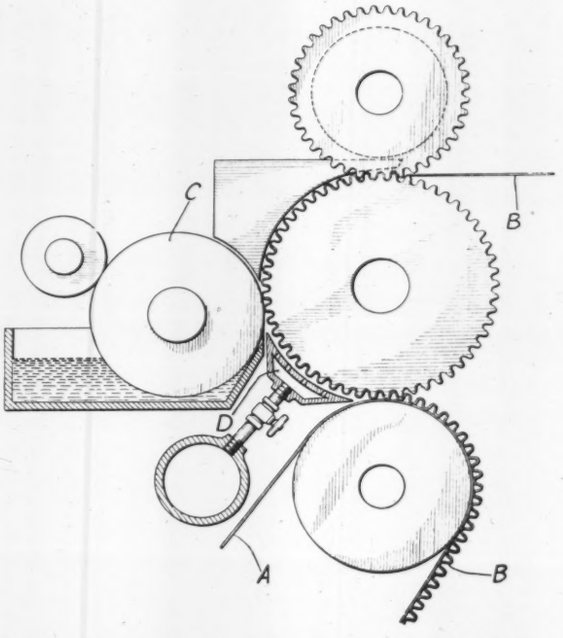
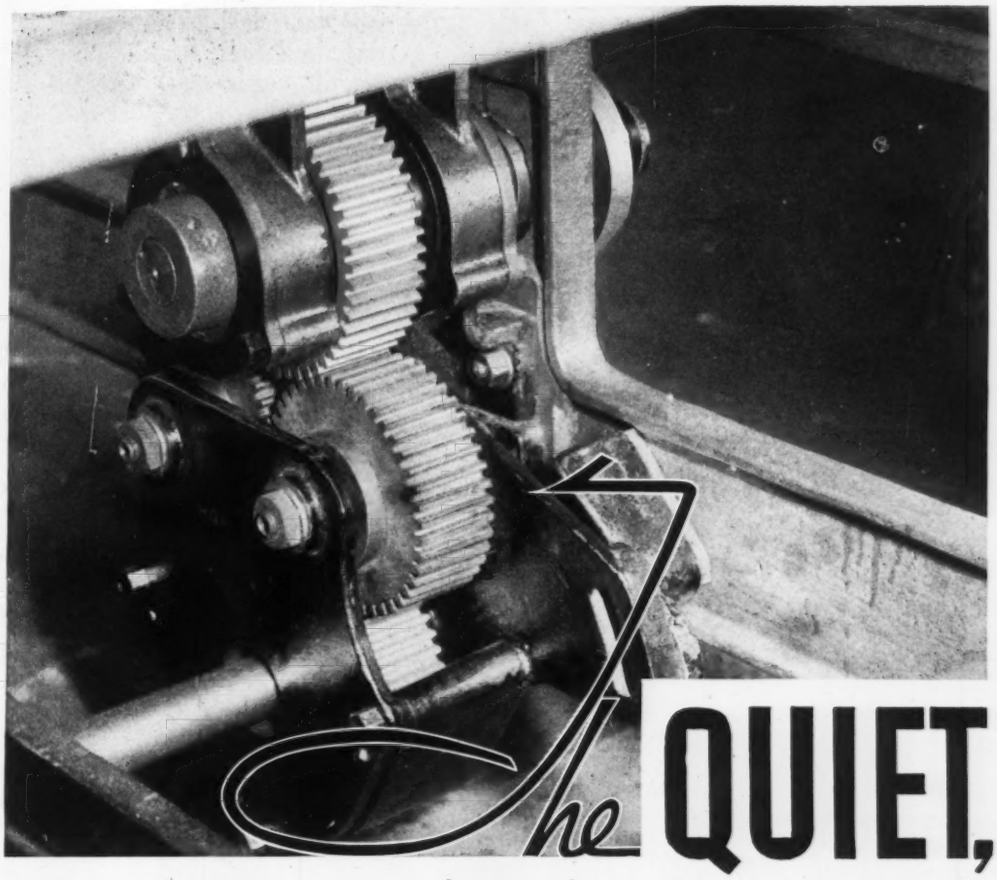


Fig. 2—Compressed air instead of finger guides holds web in mesh with corrugated roll

corrugating rolls. An adhesive or silicate roll *C* bears peripherally against the tips of the corrugated web. Instead of the usual guides or plates for engaging the corrugated web and maintaining it in mesh with the corrugated roll, a device is provided to accomplish this by means of heated compressed air, dry steam or other heated fluids. A hand valve regulates the pressure in the chamber *D* of the fluid pressure box.

The patent, designated No. 2,018,240, is assigned to George W. Swift Jr. Inc., Bordentown, N. J.

A SYSTEM designed to lubricate bearings of machines having parts that rotate at relatively high speeds is covered in a patent No. 2,010,896, assigned to Sunbeam Electric Mfg. Co. Two reservoirs are employed, the larger for storage of the oil, to prevent churning and foaming that results when the supply of lubricant is excessive. As shown in *Fig.* 3, disk *A*



The QUIET, SHOCK ABSORBING UNIT IN THE DRIVE!

Formica provides a drive unit that is quiet, elastic enough to absorb shocks, and strong and durable.

Noise creates resistance against the sale of machines, and by eliminating grind and screech of metal to metal contacts Formica makes machines more saleable.

It helps the maintenance engineer to keep everything running sweetly and smoothly.

These are the reasons why the use of Formica gears grows steadily—why the quantity sold is as great now as in 1929.

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Chicago, Ill.
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Chicago, Ill.
The Cincinnati Gear Co.
Cincinnati, O.
The Horsburgh & Scott Co.
Cleveland, O.
The Stahl Gear & Machine Co., Cleveland, O.
The Master Electric Co.
Dayton, O.
The Adams Company
Dubuque, Ia.
The Ferguson Gear Co.
Gastonia, N. C.
Hartford Special Mchny. Co.
Hartford, Conn.
Beaty Machine Works
Keokuk, Ia.
The Generating Gear Co.
Milwaukee, Wis.
Badger State Gear Co.
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Precision Machine Co.
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E. A. Pynch Co.
Minneapolis, Minn.
Joaquin Alemany Lopez
Havana, Cuba
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New York City, N. Y.
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The Pittsburgh Machine & Supply Co., Pittsburgh, Pa.
Standard Gear Co.
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H. W. Honeymon & Son
Providence, R. I.
Perkins Machine & Gear Co.
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Springbille, N. Y.
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Charles E. Crofoot Gear Corp'n, South Easton, Mass.
Arlington Machine Co.
St. Paul, Minn.
Farwell Mfg. Co.
Toledo, Ohio
Diefendorf Gear Corp.
Syracuse, N. Y.
Worcester Gear Works
Worcester, Mass.
Massachusetts Gear & Tool Co., Woburn, Mass.

MACHINES*

of all types are designed by Executives and Engineers who read Machine Design

Adding machines
Addressing and mailing machines
Agricultural machinery
Aircraft
Bakers' machinery
Baling presses
Blowers and fans
Bookbinding machinery
Bottling machinery
Calculating machines
Canning machinery
Card-punching and tabulating machines
Cars and trucks
Cash registers
Cement and concrete machinery
Change making machines
Check writing machines
Clay working machinery
Clothes pressing machines
Coffee roasting and grinding machines
Condensers
Confectionery and ice cream machinery
Conveying machinery
Cotton gins
Cranes, including hoists and derricks
Dairy machinery
Dish washing machinery
Dredging and excavating machinery
Electrical machinery
Elevators and elevator machinery
Engines, steam and internal combustion
Fare registers and boxes
Flour mill and grain mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass making machinery
Hat-making machinery
Hydraulic machinery
Incandescent lamp making machinery
Laundry machinery
Lawn mowers
Leather working machinery
Locomotives
Machine tools
Manifolding machines
Metal working machinery
Meters, gas and water
Mining machinery
Miscellaneous and special machinery
Motion picture cameras and projector
Motorcycles and bicycles
Motor vehicles
Oil-mill machinery
Oil-well machinery
Ore crushers
Packaging machines
Packing house machinery
Paint making machinery
Paper box machinery
Paper mill and pulp mill machinery
Pharmaceutical machinery
Photo-engraving machinery
Pneumatic machinery
Printing machinery
Pumps and pumping machinery
Refrigerating and ice making machinery
Road making machinery
Rolling mill machinery
Rubber working machinery
Scales and balances
Sewing machines
Shoe machinery
Slicing machines
Slot vending machines
Stokers, mechanical
Stone working machinery
Sugar mill machinery
Textile machinery
Tobacco manufacturing machinery
Transmission machinery
Typewriters
Vacuum cleaners
Washing machines, ironing machines
Welding machines
Well-drilling machinery
Windmills and towers
Woodworking machinery

***Machines as classified by the United States Census Bureau**

extends into close relation to the upper surface of chamber *B*. During operation of the device the disk dips into the oil in chamber *C*, splashing and whirling it around the interior of the mechanism. An ample portion of lubricant finds its way into the bearings.

Considerable oil is thrown, however, on to the inner surface of the closure member and drains downwardly into reservoir *D*. Therefore, when the system has been in operation a short time, the major portion of the lubricant will have been transferred to chamber *D*. Amount of lubricant which may be contained in this chamber is limited by the height of the partition, so that if too much is transferred to this chamber it will overflow back into chamber *C*. Normally, however, the oil will drain back slowly through opening *E* into chamber *C*.

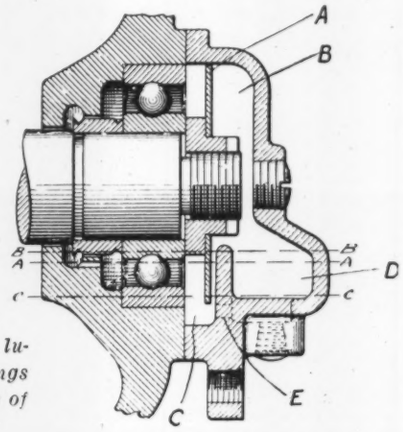

Fig. 3—Excessive lubrication of bearings is obviated by use of two reservoirs

RESILIENT mountings for machinery are many and varied, but one of particular note is covered by patent No. 2,014,467, assigned to Buffalo Forge Co. In *Fig.* 4 is illustrated the construction employed when the device is supported on a floor. One of the principal objects of the invention resides in its adjustability to any desired position as to height or level for either floor or ceiling use.

Because cushioning element *A*, which embodies flanges held together by vulcanized rubber insert *B*, is a commercial self-contained part,

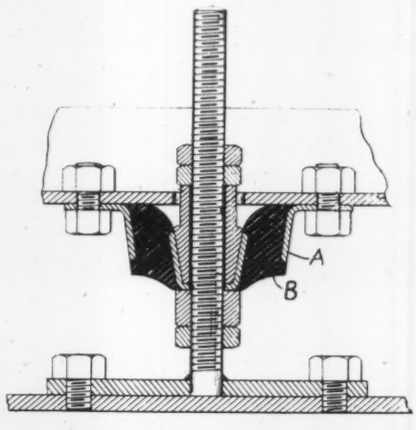

Fig. 4 — Adjustability is a feature of this resilient machine mounting

THE DESIGN WAS A *knock-out* AND THE PRODUCTS "WENT TO TOWN"

● Thousands bought these smartly styled appliances. Faultless performance pyramided sales and the manufacturers truly "went to town."

These manufacturers had the foresight to equip appliances with dependable accessories, of proven performance. They took no chance that a faulty cord set might shatter acceptance of a fine product. They knew well that "the little things count"!

Play safe — equip all of your appliances with well-engineered, reliable General Electric Accessories. G-E Connectors, Switches, Receptacles, Cord Sets, etc., assure efficient performance by your appliances. There is a wide selection. Special accessories can be designed and manufactured on request. Write Section Q-3212, Merchandise Department, General Electric Company, Bridgeport, Connecticut.

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6. Lampholder
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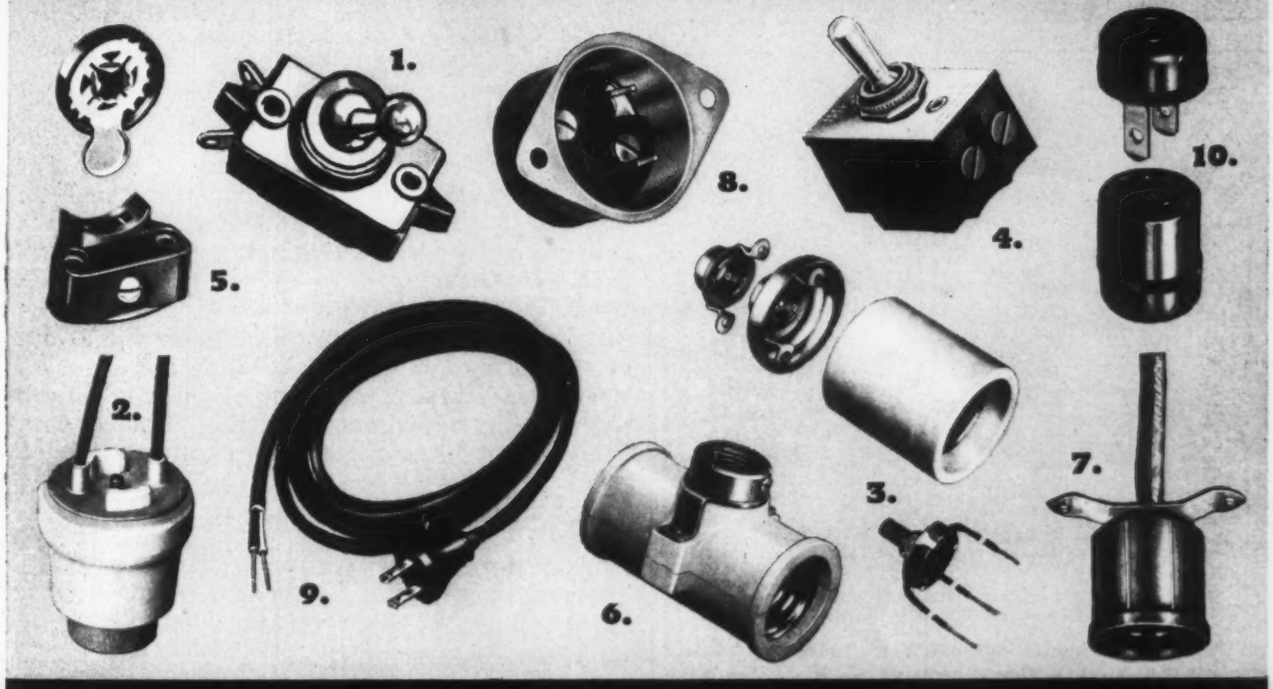
9. All-rubber Unicord
10. Textolite Connector



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MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

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Destructive Vibrations

Machine builders know that they must control destructive vibrations. First they use every refinement in machine design to reduce unbalance and the resulting resonance. Then they put the ultimate control of vibration up to Korfund Engineers and the Korfund System of Isolation.

The Korfund System of Isolation has a heavy responsibility, for it is used in the largest industrial plants, huge super-power plants, the greatest newspaper plants and the world's tallest buildings. The U. S. Navy is now installing hundreds of Korfund Vibro-Dampers under Diesel Engine sets in cruisers, gunboats, destroyers and submarines.

Put your Isolation problems up to us.

The section of a Punch Press shown, is mounted on Korfund Vibro-Dampers.

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THE TAPERED EDGE

SEALS WITH MINIMUM FRICTION

The tapered edge of the leather washer is a vital feature of the Gits Precision Oil Seal.

The leather is so flexible at this tapered edge that only a slight pressure of the flat spring clamp ring, located at this point, is required. Friction on the shaft is therefore reduced to a minimum. Moreover this sharp tapered edge prevents the escape of oil by shearing the oil film.

Send for a descriptive folder.

GITS BROS. MFG. CO.

1861 So. Kilbourn Ave., Chicago, Ill.

GITS Precision Oil Seal

the arrangement is comparatively simple, but extremely effective. This device typifies another instance where an alert engineer got in on the "ground floor" with a vibration and noise eliminating idea.

IMPROVEMENTS in a coin slide, *Fig.* 5, embody a chisel dog to intercept and stop entry of soft slugs in the coin-operated release mechanism of a vending machine. These are covered in a new patent, No. 2,010,360, assigned to Monarch Tool & Mfg. Co., Cincinnati. When a proper size slug of cardboard, lead or other comparatively soft material is placed into the receiving aperture *A* and the slide *F* advanced, cutter point or chisel edge *B* of a spring-controlled dog

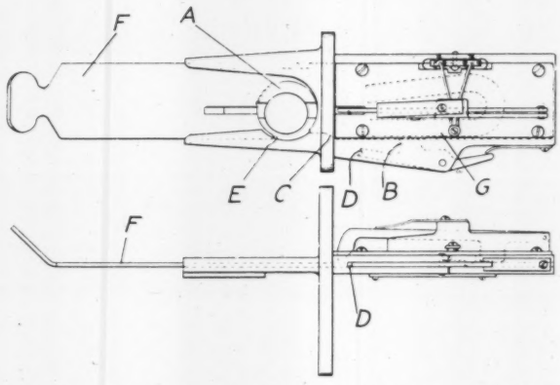


Fig. 5—*Chisel dog intercepts entrance of soft slugs in slide*

will move inwardly over incline *C*, shaving or indenting the edge of the soft slug. This brings stop end *D* into arresting engagement with an abutment *E* of slide member *F*. When the proper coin is placed within the aperture, however, advancement of the slide causes abutment *G* of the dog to ride over the periphery of the coin edge, thereby maintaining stop end *D* out of the path of movement of slide abutment *E*. Perforated, thin or magnetic coins or slugs are rejected by a magnet or a dog, this feature being covered in a co-pending application.

Other Recent Patents in Brief

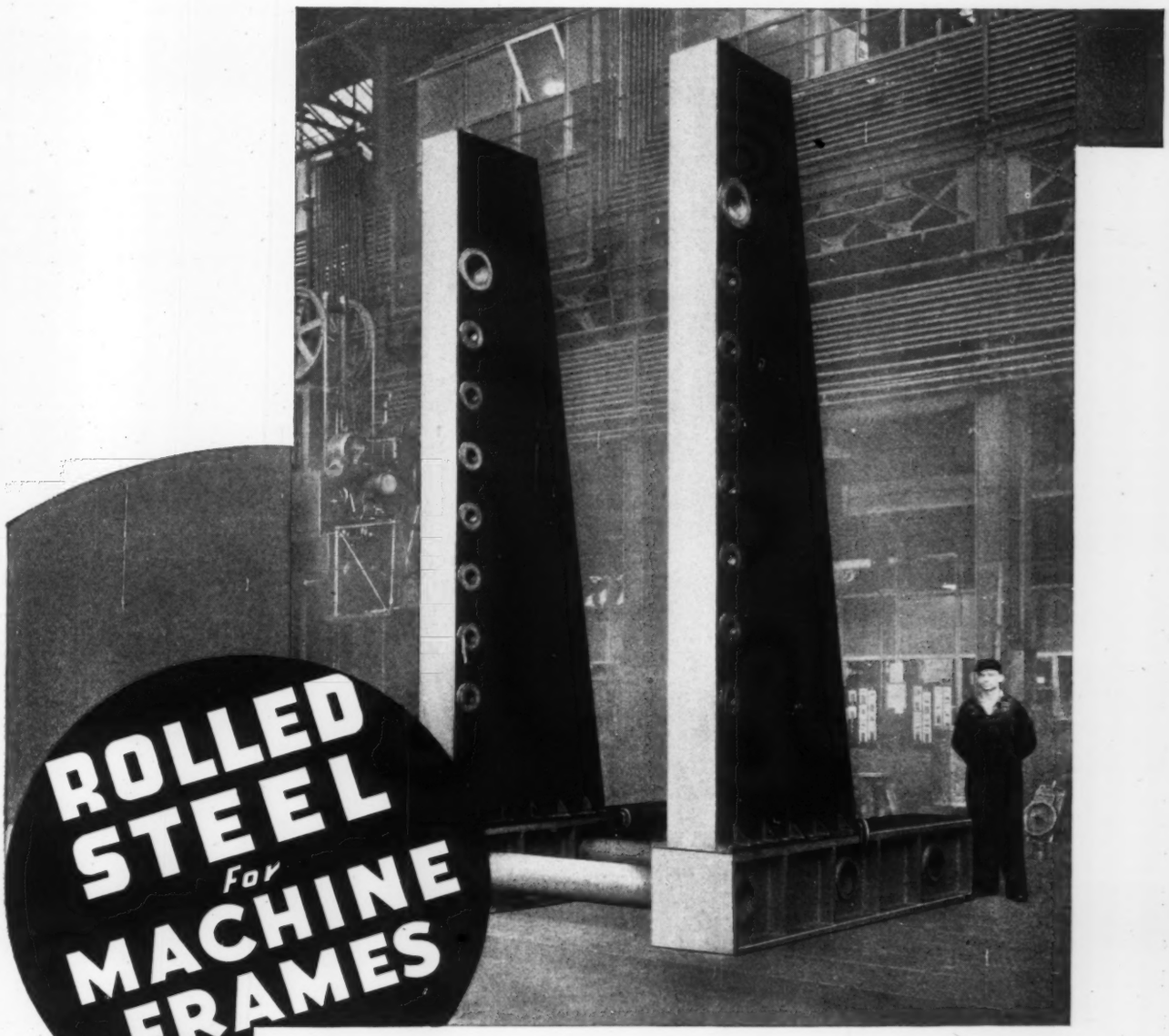
SPRING WINDING MACHINE—2,021,276—Four claims. Howard W. Weinhart. Assigned to Bell Telephone Laboratories Inc., New York.

VACUUM CLEANER—2,021,298—Seventeen claims. Axel A. Forsberg, Assigned to Electrolux Corp., Dover, Del.

HYDRAULIC PUMP OR MOTOR—2,021,353—Seven claims. Walter Ernst. Assigned to Hydraulic Press Mfg. Co., Mt. Gilead, O.

SHAFT SEAL—2,020,436—Five claims. Francis Shenton. Assigned to Frick Co., Waynesboro, Pa.

CARD SORTING MACHINE—2,020,925—Fifteen claims. Douglass A. Young. Assigned to Westinghouse Electric & Mfg. Co.



ROLLED STEEL *For* MACHINE FRAMES

WHEN you use rolled steel for machine frames, you always have just the weight and strength you need, without excess.

Whether it's a frame welded up from ½-in. plates or from 6-in. plates, it can be designed solely to meet the requirements of the product itself... without costly concessions to production limitations.

Often the adoption of rolled steel eliminates many items of expense, reduces the amount of machining required, reduces weight by employing heavy construction only where it is needed to meet heavy stresses.

ROLLED STEEL OFFERS THESE ADVANTAGES

1. Cheaper . . . for most parts.
2. Reduces loss due to defects or discards.
3. Permits inexpensive changes in design.
4. Faster production . . . particularly of new and unstandardized parts.
5. Reduces inventory and pattern storage.
6. Permits prompt adaptation of standard design to special requirements.
7. Eliminates excess weight.
8. Modernizes appearance.

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Booth
PRECISION CUT FELT

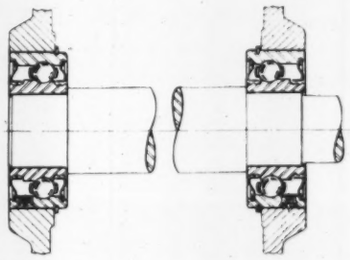
593

NEW *Materials and Parts*

Protects Bearings with Seals

COMPLETELY enclosed cartridge type single-row units, designated as the "3000" series, have been added to the line of protected bearings being manufactured by Norma-Hoffmann Bearings Corp., Stamford, Conn. Although having but one row of balls, the new series has inner and outer rings of standard double-row width. The bearing, shown herewith, is completely enclosed, and protected on both sides, by metal seals of special design held firmly in place by snap rings in the outer race. These metal seals have a long inwardly projecting flange with a close running fit over the grooved and recessed inner ring.

Improved bearings are completely enclosed and protected on both sides by metal seals of special design



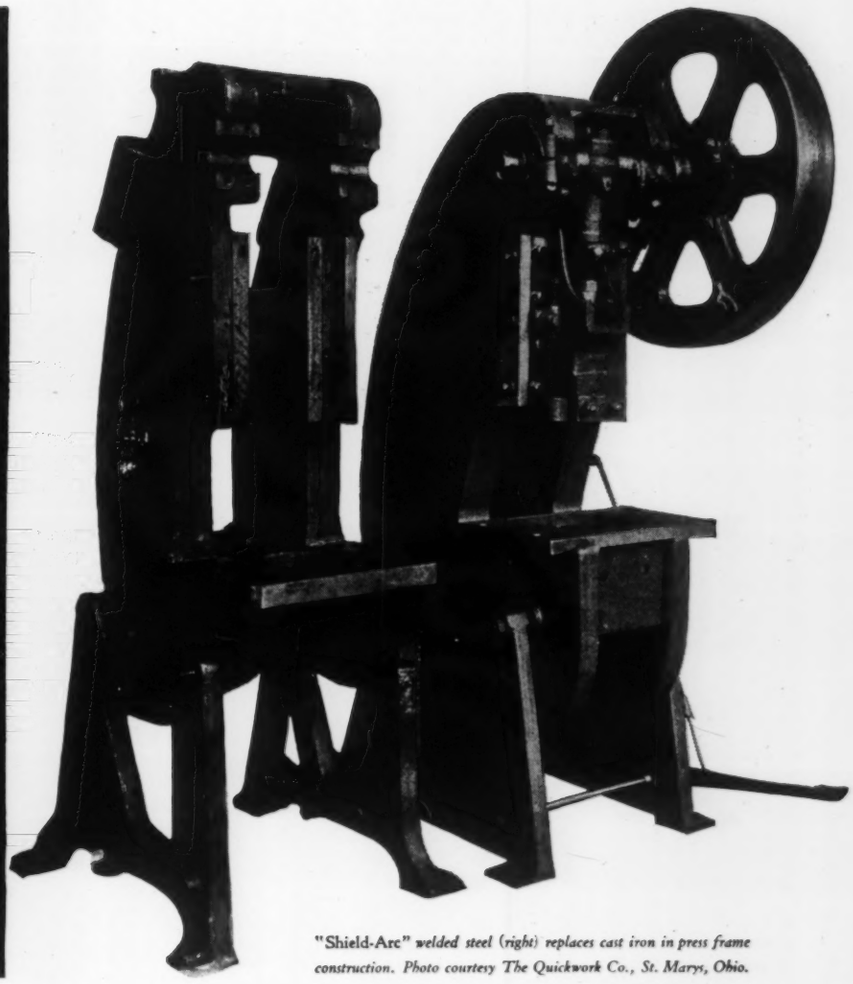
By use of the wide inner and outer rings exceptionally large grease capacity is afforded and looseness or "peening" of either shaft or housing is obviated by the greater contact area the wide rings provide. The new bearings can be furnished either with or without a filling plug for renewal of grease. The series is made chiefly in the medium sizes starting at 25 mm. bore.

Introduces Improved Thermostats

STRIP and pencil type thermostats in improved designs are a recent development of George Ulanet Co., 85 Columbia street, Newark, N. J. The strip type unit is housed in an aluminum casting for convenient mounting on flat surfaces. Its dimensions are 4½ by 1¼ by 1¾

Strip type thermostats are designed for mounting on flat surfaces

FREE
—Extra Machine Service Life with "*Shield-Arc*" Welded Steel



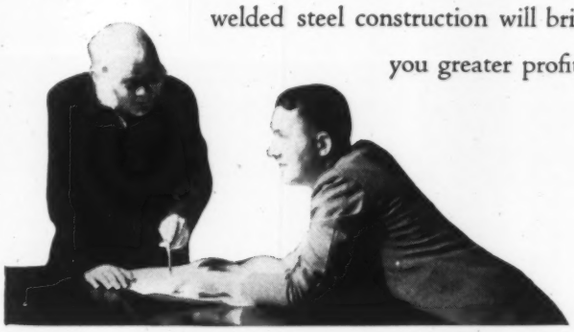
"Shield-Arc" *welded steel (right) replaces cast iron in press frame construction. Photo courtesy The Quickwork Co., St. Marys, Ohio.*

As an example, this steel press frame, "*Shield-Arc*" welded, is many times stronger, much more durable, yet lighter and less costly to build than the cast iron frame it replaces. Thus the customer gets extra machine life at no extra cost.

How about your own machines and your own customers? Why run a chance of someone else offering them greater value first? Especially when the shift to "*Shield-Arc*" welded steel construction will bring you greater profits?

"*Shield-Arc*" welding simplifies construction and cuts costs all along the line in machinery building. Profits start with purchase of materials, grow with simplified production (no patterns), mount up with increased sales of better products.

But remember—to get all the profits from welding, you must use the "*Shield-Arc*" welder, guaranteed three ways to produce more welding per dollar. Find out what this guarantee means to you. Ask THE LINCOLN ELECTRIC CO., Dept. C-159, CLEVELAND, OHIO. Largest Manufacturers of Arc Welding Equipment in the World.



LAD "But, listen, don't you think other welders have a right to live?"

POP "Sure, but not too long. If they aren't keeping the user's costs in line with those of '*Shield-Arc*' users, then they'll both have to move to Dodoland where the survival of the fittest doesn't obtain."

THE LINCOLN ELECTRIC CO., Dept. C-159, Cleveland, Ohio

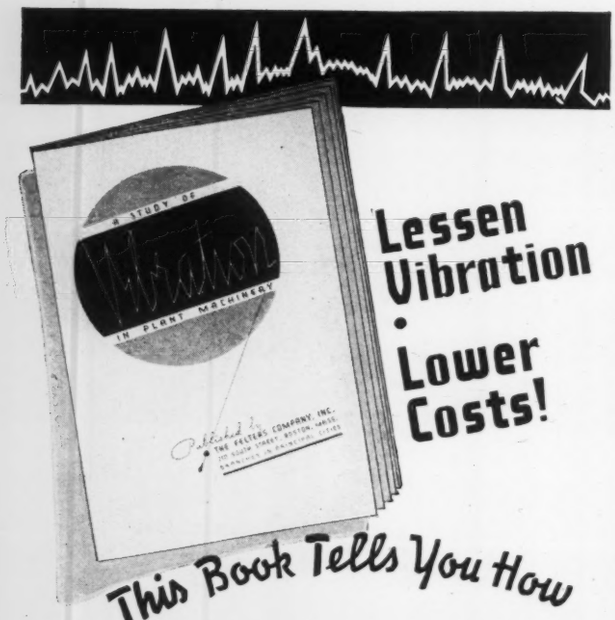
How can I build extra service life into my machines at no extra cost with "*Shield-Arc*" welded steel?

Firm .....

Your Name ..... Title .....

Address .....

City ..... State .....



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This Book Tells You How

For years vibration in rotating and reciprocating machinery has been regarded as an unescapable evil—a costly consort to production. But exhaustive researches have proven that vibration with all its economic waste can be greatly lessened. These facts, as they were developed from our research, are embodied in a new book, "A Study of Vibration in Plant Machinery." Send for a copy. It's yours for the asking.

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OIL BURNER MOTOR UNIT

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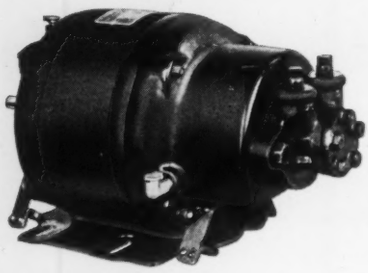

This design simplifies oil burner assembly and service. Our engineers are ready and willing to cooperate in the simplifying of your motor problems. Write Dept. 14 for information regarding your applications.

HOLTZER-CABOT ELECTRIC CO.

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inches. The standard is adjustable by means of a phenolic resinold adjustment knob up to temperatures of 550 degrees Fahr. Temperature differential is 5 degrees. Recommended electrical rating, 1000 watts alternating current at 220 or 110 volts.

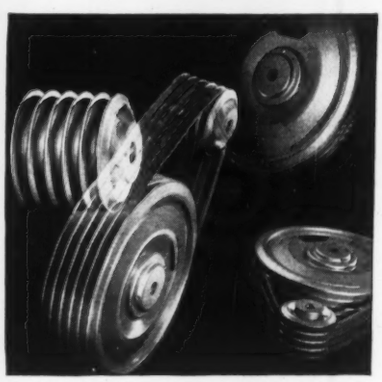
The pencil type thermostat, shown herewith,

Pencil type thermostat is intended for immersion in liquids, electric ovens and heating plates

is for immersion in liquids, electric ovens and heating plates on molding presses and automatic machinery. Its capacity is 2000 watts alternating current, 900 watts direct current at 110-220 volts. The standard temperature range is 500 degrees Fahr., but the unit can be built for higher temperature ranges. Temperature differential is one degree Fahr. Length of tube (8 inches standard), may be varied, depending on the sensitivity desired.

Enlarges Line of Sheaves

ADDITIONAL stock sizes have been added to the line of "Texsteel" sheaves for V-belt drives manufactured by Allis-Chalmers Mfg. Co., Milwaukee, now making it possible to furnish these drives up to 15 horsepower. Grooves of the entire line are so designed that they can be used with A-section belts (½ by 11/32-inch) or with B-section belts (21/32 by 7/16 inch), depending on the application. The standard line now includes 25 different diameters of sheaves

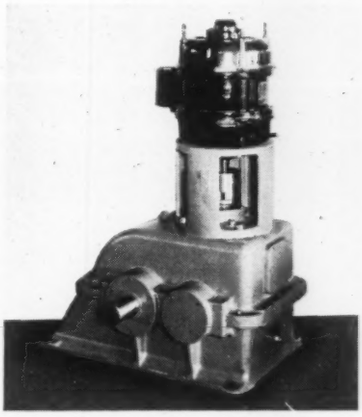


Additions to line of steel sheaves increases range of V-belt drives which may employ these sheaves

from 3 up to 18 inches inclusive for any number of grooves from 2 to 6 inclusive. All these sheaves are available with interchangeable type hubs with bores in 1/16-inch increments from ½-inch up to the maximum bore.

Reducers Employ Two Types of Gears

A NEW type speed reducer which consists of a combination of spiral bevel gears and continuous tooth herringbone gears with motor mounted on top has been introduced by D. O. James Mfg. Co., Chicago. This unit, shown herewith, makes a unique horizontal drive, occupying a minimum of floor space. Roller bearings are used throughout in the reducer, all bearings and gears being lubricated by force feed by an oil plunger pump submerged in the oil inside of the case. A complete range of sizes has been developed with a horsepower range from 1 to 200. Range of ratios is from 8:1 to 45:1 and higher.



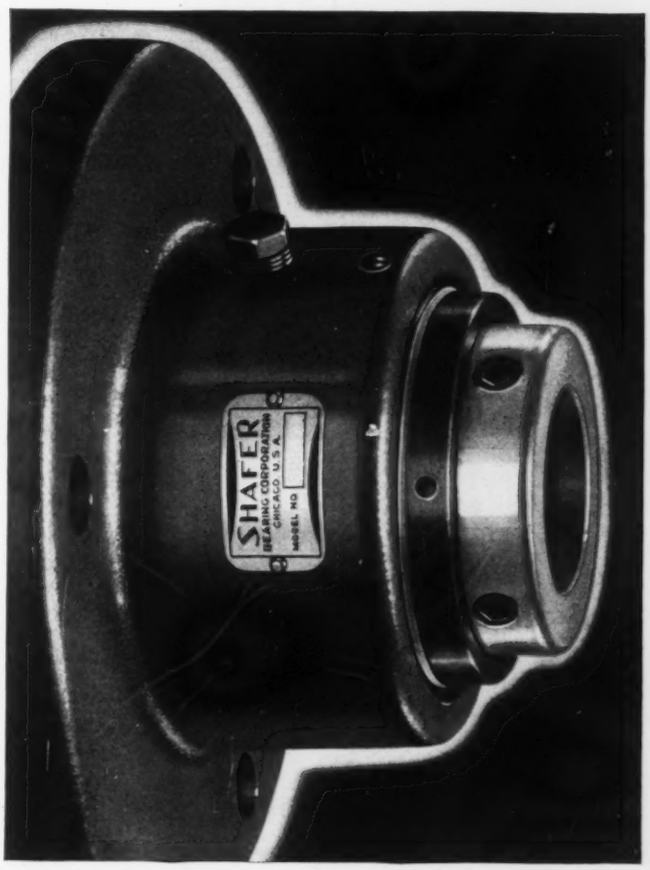
A combination of spiral bevel gears and continuous tooth herringbone gears with motor mounted on top is employed in new reducer

---

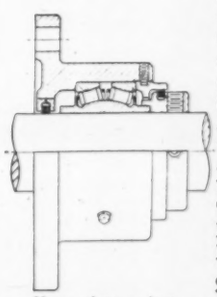
Provides High Speed Operation

HIGH speed operation is achieved in the type LTZ line-arc contactors of Electric Controller & Mfg. Co., Cleveland by the use of aluminum alloy construction. The contactors, shown herewith, are made with a full floating, resiliently mounted armature. The flexible union between core faces not only insures even meeting of the pole faces but also gives an added impetus in opening the contactor.

Bearings used in these contactors are of the self-lubricating type and are of self-aligning, spherical design. Contacts are made by a new and special process which has produced a metal having great resistance to wear. By application



This Bearing Adapts Itself to the Job . . . The Shafer Flange Unit is an ideal mounting for many uses where correct bearing application would otherwise be difficult. Exact alignment of mounting surfaces is not required because automatic compensation is provided by the self-aligning action of the bearing itself. • Only Shafer Bearings, with their exclusive CONCAVE roller design, combine—1. Generous capacity for any combination of radial-thrust loads. 2. Integral self-alignment. 3. Simple adjustability. • Shafer Flange Units mean simplest installation, free-rolling full capacity performance, and long life with minimum attention. Catalog 12 gives data on Flange Units, Pillow Blocks, Cartridge Units, Take-up Units, Duplex Units, Hanger Boxes, Conveyor Rolls, Radial-thrust Roller Bearings.

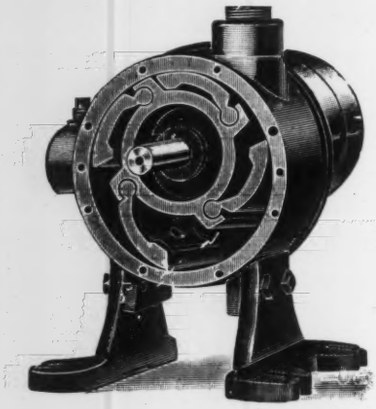


Note piston ring seals and square drive collar.

SHAFER BEARING CORPORATION
6513 W. Grand Ave., Chicago, Ill.

SHAFER
roller bearing
FLANGE UNITS

Standard Equipment on all sorts of Air Using Devices and used by the world's leaders . . . . . .



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Patented Rotary Positive

AIR PUMPS

for pressure, vacuum and gas pumping.

AIR MOTORS

They take up their own wear

NEW POSSIBILITIES OF DESIGN IN AUTOMATIC MACHINES and DEVICES readily suggest themselves as you study the various present uses of these pumps.

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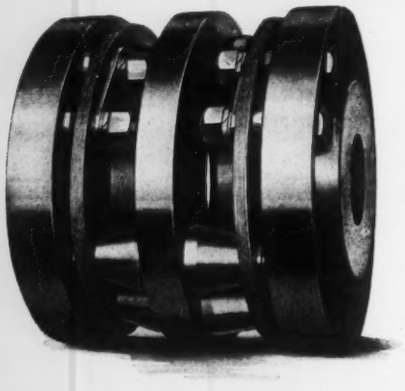
Makers of Good Machinery for 45 Years

KEEPS 'EM RUNNING



EXPENSIVE MACHINERY Deserves the Full Protection of this Inexpensive Coupling

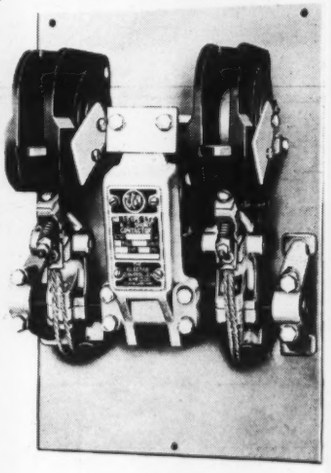
TYPE "DBZ" SHOWN FOR HEAVY DUTY, HIGH SPEED MOTOR AND ENGINE DRIVES

DELAYED shut-downs due to coupling failure not only increase maintenance costs and production interference—but reflect a bad judgment upon the builder of the drive or driven unit, responsible for its selection.

Guard your established good-will by equipping your product with the Thomas Flexible Coupling. They operate without destructive back-lash, friction, point or line contacts, noise, wear or lubrication . . . May we mail you the helpful Thomas catalog?

THOMAS FLEXIBLE COUPLING COMPANY
WARREN, PENNA.

of the line-arc principle the arc is immediately removed from the contacts as soon as they start to separate and is transferred to the arcing plate and blowout guard. These contactors are built

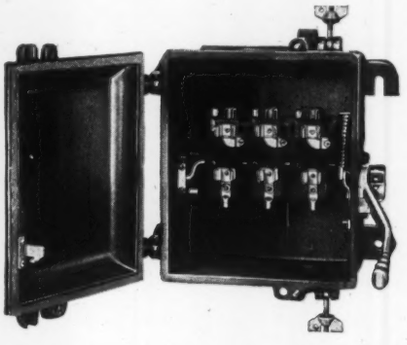


Aluminum alloy construction of line-arc contactors permits higher speeds of operation

in single, double and triple pole style and are arranged for terminal connections either at the front or rear of the contactor base.

Switches Centrifugally Operated

DUALBREAK safety switches, mounted in weatherproof cast iron cabinets, have been added to the line of industrial switches manufactured by Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. These type A switches, shown



Switches are built to stand up under extreme operation conditions where excessive moisture is present

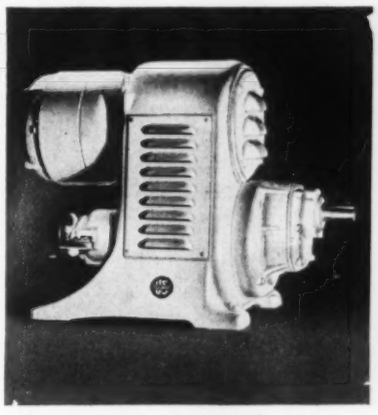
herewith, are built to stand up under extreme operating conditions where excessive moisture, dust, lint or corrosive agents may be present. The switching mechanism is quick make and quick break. Covers are bolted to the cases with noncorroding eye-bolts and wing nuts, the eye-bolts on the left side acting as hinges. The operating handle has a dust-tight bearing and is equipped with facilities for locking the handle

in the "off" position. Cover has positive interlock for assured safety.

Applications for these new heavy duty switches include machines to be used in cement, flour, steel and paper mills as well as breweries, chemical and woodworking plants, grain elevators, dairies and warehouses where combustible materials are stored. Models are rated up to 50 horsepower and the switch is available fused or nonfused.

Introduces Upright Transmissions

UPRIGHT designs which permit a saving in lateral space over horizontal designs of varidrive transmissions are now being offered by U. S. Electrical Mfg. Co., Los Angeles. This design, shown herewith, also gives the user the option of having the take-off shaft at either the high or low position. The horizontal design is used where the overhead space rather than lateral space is limited. Varidrive transmissions provide infinite variations in speed with local or remote control available.



Upright designs of infinitely variable speed transmissions permit a saving in space

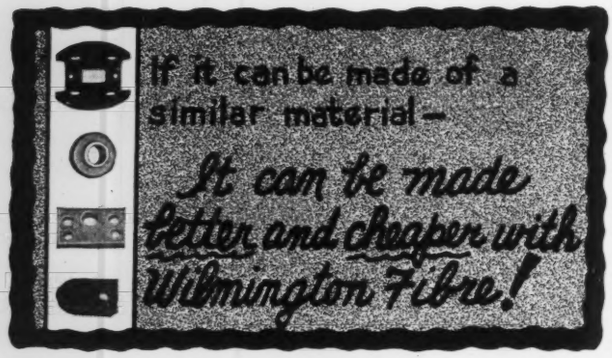
Hydraulic Units Are Self-Contained

SELF-CONTAINED hydraulic feed units designed for production drilling and kindred operations are a recent development of Hoefer Mfg. Co., Freeport, Ill. The motor, mounted on the rear of the new hydraulic unit is directly connected to an intermediate shaft driving the herringbone geared oil pump, located in the oil sump, totally submerged at all times. The main spindle is driven from this shaft through splined pick-off gears, one hardened and one nonmetallic, which permit variation of the spindle speeds.

Work cycle can be changed simply from con-

More than ten years ago Master pioneered the first integrally built Geared Head Motor. Each year since that time more Geared Head Motors have borne the Master nameplate than any other. What better recommendation could even the shrewdest buyer have than the continued preference by the majority for Geared Head Motors built by Master?

THE MASTER ELECTRIC COMPANY
DAYTON OHIO U S A



The ease with which Wilmington Fibre may be fabricated into parts of practically any desired shape will reduce production costs and time. These economies are increased further when the facilities of our plant are utilized to produce the *finished* parts.

Yet quality, far from being sacrificed, is increased . . . for vulcanized fibre is light, yet tough; strong; attractive; resistant to corrosion; and a perfect insulator . . . without having any of the disadvantages of other materials.

Write for the FREE catalog for complete details.

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WILMINGTON FIBRE SPECIALTY COMPANY
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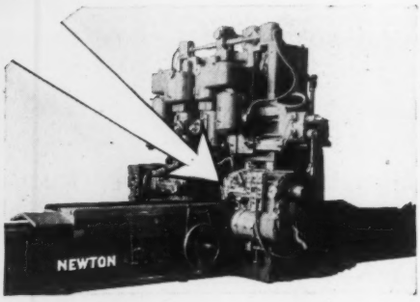
PULLMORE CLUTCHES
USED IN
NEWTON MILLING MACHINES

Pullmore Clutches are used in the feed and rapid-traverse mechanisms of Newton Unit-Head Planer-Type Milling Machines shown below. Responding to our inquiry, the Consolidated Machine Tool Corporation, Rochester, N. Y., manufacturers of this and other machine tools, write, "The Pullmore Clutch, as used on this machine, is giving very satisfactory results." Reasons—Pullmore pulling power, reliability, durability, and adaptability to machine design.

For the same reasons Pullmore Clutches are used with marked success in many kinds of machinery. Investigate! Write for catalog, today.

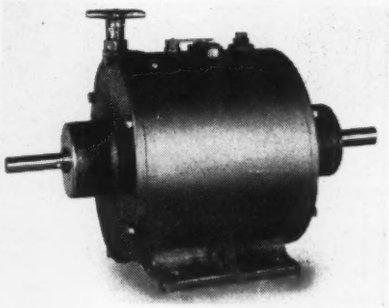


ROCKFORD DRILLING MACHINE CO.
304 Catherine St. Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y.
With offices in principal cities

tinuous to interrupted, or vice verse. Spindle speeds are changed by means of pick-off gears. The units may be operated in any position to suit the requirements of the work, horizontally, vertically, or at any angle. Any number may be used with the application.

Provides Infinite Speed Variations

DESIGNED for use between prime movers and machines where a low variable speed is necessary or desirable, the new variable speed transmission of Lenney Machine & Mfg. Co., Warren, O., provides speeds adjustable to a



Speed with new transmissions is adjustable to a fraction of a revolution per minute at any time

fraction of a revolution per minute at any time (before starting or while running). The overrunning clutch is employed in the transmission, shown herewith. Mounted on the input shaft are cams which, through cam yokes, connecting links and gear segments, operate the three overrunning clutches. There are three cam movements actuating the three clutch driving collars with each revolution of the input shaft, which produces a uniform and steady flow of power to the output shaft. With a 1750 RPM input there are 5250 clutch impulses per revolution of the output shaft.

Plastic Resists Dielectric Fatigue

TO MEET the demand for a plastic material with higher dielectric breakdown and dielectric fatigue than is available with standard materials, General Plastics Inc., N. Tonawanda, N. Y., has developed a material called 2491, available in black, brown and red. This new material is being employed on rotors and coil caps for the 1936 automobiles. According to ASTM tests recently completed, Durez 2491 has a dielectric breakdown of 550 V/M, and a dielectric fatigue of 400 V/M/M. When exposed to high tension current leakages, this special material resists the formation of carbon tracks or arcing channels.

Machine Safety—A Design Necessity

(*Concluded from Page* 28)

of the shaft causes this lever to shut off the switch and thus shut down the machine.

This simple mechanism protects the machine from jamming through cans getting out of position at the only point where such jamming might occur. It was made necessary by inequalities in milk cans, differences in size or condition, especially the latter, which cannot be controlled by the maker of the machine.

The same inequalities in cans as regards height or varying openings, and inequalities in the can caps made necessary further safety devices at the point of cap delivery. Inasmuch as the delivery of the can cap involves two mechanisms, one for shoving the caps on to the cans and one for tilting the cap hopper into a horizontal position, two safety devices are required.

Cams Actuate Arms

Caps are shoved on to the cans by two arms which can be seen at the top of *Fig.* 5. These arms receive their impetus from one of the several operating levers actuated by a cam. As can be seen from the illustration, the turning of arm *R* about the shaft turns the arms by the action of a curved surface against a small lever. This lever is maintained in contact with the curved surface by the spring shown. Should the arms be stopped in their forward movement, the small lever would be forced out of engagement against the action of the spring and no damage would result to the machine.

Turning of the can hopper from the vertical to the horizontal is brought about by the lever at *S, Fig.* 3, again being actuated by a cam. The end of this lever can be seen at the bottom of *Fig.* 1. As the lever rises, the counterweight shown pulls the chain around the oval sprocket which is eccentrically mounted on the shaft, thus tilting the cap hopper.

Connection between the lever and the chain is made through a spring riding in the tube shown. If, on the return of the hopper to the vertical, some exterior factor should block the travel, this spring would give, thus providing a flexible connection which eliminates the possibility of serious damage.

Through these few simple steps an automatic mechanism is completely protected against forces beyond the control of the man building the mechanism. Such control against external forces is of extreme importance to the designer. A machine might be condemned through failure of the designer to look ahead of his immediate problem and take in all possible contingencies.

Calendar of

MEETINGS *and* EXPOSITIONS

MACHINE exhibitions are very valuable to the designer . . . . They afford the opportunity of obtaining new ideas . . . . As the result of many months of careful designing the machines shown usually include undreamed of innovations * * * The Machine Tool Show opened what promises to be one of the most successful exposition seasons on record . . . . However, this mammoth exhibition displayed only one division of the design industry . . . . Automobile shows are now holding the center of the stage, giving another angle to the designer's work * * * In January, three more fields are to be covered . . . . Coin machinery, a fast moving and progressive field, will be on display in Chicago . . . . Road building equipment will be shown at Cleveland . . . . Air condition equipment, heating and ventilating mechanisms are to be displayed in New York.

Jan. 13-16—

Coin Machine Show. Annual exhibition sponsored by National Association of Coin-Operated Machine Manufacturers to be held at Hotel Sherman, Chicago. C. S. Darling, 120 South LaSalle street, Chicago, is secretary.

Jan. 20-24—

American Road Builders association. Annual meeting and exhibition of equipment to be held at Municipal Auditorium and Exhibition Hall, Cleveland. Charles M. Upham, National Press building, Washington, is managing director.

Jan. 27-31—

International Heating and Ventilating Exposition. Fourth exhibition to be held at International Amphitheatre, Chicago. Information may be obtained by addressing the Exposition at Grand Central Palace, New York.

Jan. 28-31—

American Institute of Electrical Engineers. Winter meeting to be held in New York. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary.

March 3-6—

American Management association. Annual packaging conference and exhibition of machines to be held at Hotel Pennsylvania, New York. Alvin E. Dodd, 20 Vesey street, New York, is executive vice president.

March 9-12—

National Railway Appliances association. Annual exhibition of machines and equipment and annual meeting at the Coliseum, Chicago. C. W. Kelly, 910 South Michigan avenue, Chicago, is secretary.

March 10-12—

American Railway Engineering association. Annual meeting at the Palmer House, Chicago. E. H. Fritch, 59 East Van Buren street, Chicago, is secretary.

FOR MAXIMUM QUIETNESS AND ENDURANCE

OPEN TYPE BALL BEARING
SELF-ALIGNING BALL BEARING
CLOSED TYPE BALL BEARING
CYLINDRICAL ROLLER BEARING
SINGLE FELT SEAL BALL BEARING
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"NORMA-HOFFMANN"
PRECISION BEARINGS
BALL, ROLLER AND THRUST

Write for free Catalog and Engineering Counsel

NORMA-HOFFMANN BEARINGS CORP'N, STAMFORD, CONN., U.S.A.

MANUFACTURERS' PUBLICATIONS

BEARINGS—Fafnir Bearing Co., New Britain, Conn., is distributing a bulletin which includes a comprehensive discussion of the bearing problems of machine spindles, and of the types of ball bearings required in such applications. A review of the development of the preloaded duplex bearings and of the various types and arrangements now available is included.

BEARINGS—Bearing bronzes and other bearing metals are completely presented in new sheets for the "Bearing Metal Data" book of Federal-Mogul Corp., Detroit. New metals of the company are discussed in detail and photomicrographs show the composition. The subject matter covers aluminum bronzes, and tin base bearing alloys.

CONTROLS (ELECTRICAL)—Recent innovations in magnetic contactor design are presented in a folder of Electric Controller & Mfg. Co., Cleveland.

CONTROLS (ELECTRICAL)—Ward Leonard Electric Co., Mount Vernon, N. Y., is distributing new catalog inserts on direct current automatic motor starters in a great many types.

CONTROLS (ELECTRICAL)—Gamewell Co., Newton, Mass., has issued a data sheet covering its new cam lever switch, designed for use in circuits where the break-down requirements do not exceed 2500 volts.

CONTROLS (ELECTRICAL)—Bearing-temperature relays, instantaneous, bellows-type, hand set relays for protecting machine bearings against abnormal heating are discussed in catalog insert GEA-2209 of General Electric Co., Schenectady, N. Y.

CONTROLS (ELECTRICAL)—Complete details on pushbuttons, many types of switches, across-the-line and automatic starters, regulators, reversing controllers, rheostats, limit switches, direct and alternating current brakes, mechanical brakes, flexible couplings and a number of additional electrical controls are given in the new catalog of Clark Controller Co. and Sundh Electric Co., Cleveland.

CONVERTERS—Rotary converters for converting direct current to alternating current are covered in bulletin 13-I of Janette Mfg. Co., Chicago.

FASTENINGS—Pheoll Mfg. Co., Chicago, is distributing a most complete catalog which includes American standard dimensional data, weight tables and other information on the subject of screws, bolts and nuts as well

How the
REEVES VARI-SPEED MOTOR PULLEY
provides infinite speed regulation over a 3:1 range

Applicable directly to the regular shaft of any standard constant speed motor, the REEVES Vari-Speed Motor Pulley forms the actual driving element between motor and machine.

Any speed whatever between minimum and maximum limits is made available to fractions of revolutions, depending on position of motor on its sliding base. By turning a speed control handwheel, the motor is moved forward or backward, as desired.

When motor is *farthest* away from driven shaft, the REEVES V-belt assumes *smallest* arc of contact or diameter formed by the discs, and *minimum* speed is obtained on driven pulley (One disc slides laterally, but is *always* held in *positive* contact with the REEVES V-belt by means of compression spring.)

When motor is *nearest* to driven shaft, the V-belt assumes the *largest* diameter, and *maximum* speed is obtained on the driven pulley.

This simple, compact, efficient, low cost unit, is used as standard equipment on a wide variety of production machines. Furnished in seven sizes for motors from fractional to 7½ H. P.

★

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

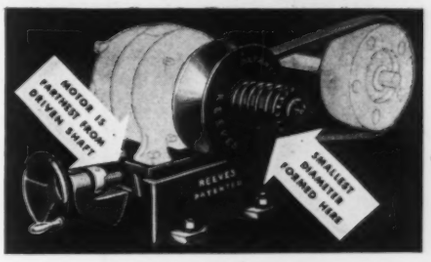
Send full description of the REEVES Vari-Speed Motor Pulley and examples as contained in catalog H-300.

(12-35)

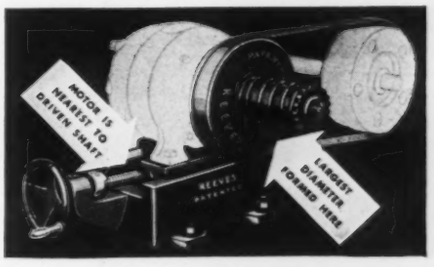
Name.....

Company.....

Address.....



Position at Minimum Speed



Position at Maximum Speed

as data on the company's standard line of fastenings which includes machine screws, cap screws, setscrews and many other types of screws, bolts of all types, knurled, cap and wing nuts, washers, threaded rods, wires and studs and similar parts.

FINISHES—Amaloy, a hot dipping process which coats the base metal with a single solid solution of lead is described in new bulletins of American Machine & Foundry Co., New York.

FRICTION MATERIALS—Descriptions of a complete line of industrial friction materials, including the woven and compressed and the folded and compressed products of the flexible types and the friction block and molded varieties of the rigid styles are included in a new brochure FM-4A of Johns-Manville, New York.

GEARS—Foote Bros. Gear & Machine Co., Chicago, has prepared a pocket size, 128-page handbook which contains complete information and data with many curves and tables on worm gearing. One section of the handbook is planned for the convenience of the design engineer who wishes to lay in a worm and worm gear as an integral part of his design.

MOTORS—Reliance Electric & Engineering Co., Cleveland, has brought out bulletins 120 and 121 covering fully-enclosed fan-cooled induction motors.

MOTORS—Special designs of alternating current fractional horsepower induction motors in rigid horizontal and vertical flange mounting types, and outline dimensions of alternating current fractional horsepower induction motors in rigid and resilient base mounting types are presented with dimensional drawings and size tables in two bulletins of Ohio Electric Mfg. Co., Cleveland.

PIPE—The various types of tubular products manufactured by Republic Steel Corp., Massillon, O., and its subsidiary, Steel & Tubes Inc., is given in a 16-page folder of the company.

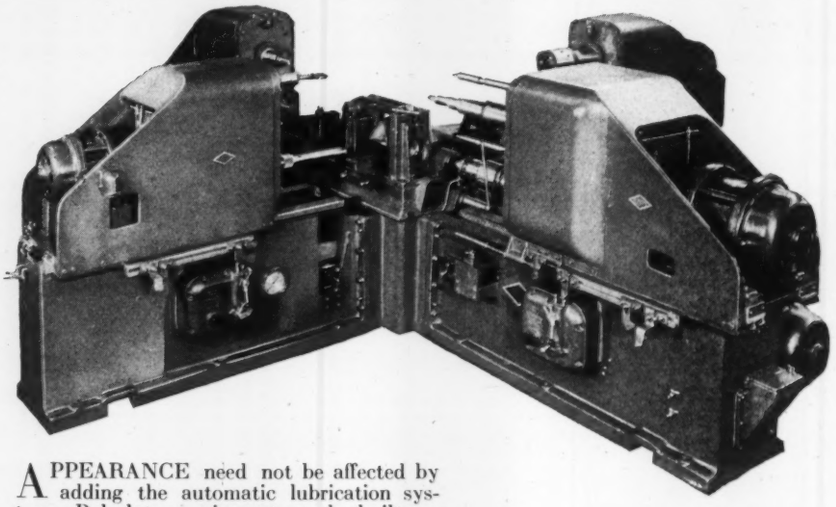
REFRACTORY MATERIALS—The story behind many of the refractory products manufactured by Johns-Manville, New York, and the properties of the materials, is given in a new booklet of the company entitled "Fire Tamers."

VIBRATION DAMPENERS—Felters Co., Inc., Boston, has prepared a comprehensive booklet which includes a complete study of vibration in plant machinery. The possibility of dampening vibrations by the use of wool felt is discussed and the actual results achieved in a number of installations are presented. Practical methods of isolating the machine are covered in detail.

WELDED PARTS AND EQUIPMENT—Construction of the welded steel base for a new propeller profiler is covered in a folder of Lukenweld Inc., Coatesville, Pa. Other recent publications the company discuss the welded lightweight rigid base on a drilling machine, and the saving of 1,000 pounds weight in the welded frame of a hydraulic press.

Customers demand

AUTOMATIC OIL LUBRICATION



INDUSTRY now realizes that modern machine tools with their amazing refinements and high production qualities require automatic lubrication.

BLANCHARD PULSOLATOR is a centralized automatic oiling system designed to insure perfect lubrication to every bearing and to control excessive maintenance costs on modern machine tools. Our engineers can design these features into your machines by the application of PULSOLATOR.

APPEARANCE need not be affected by adding the automatic lubrication system. Pulsolator equipment can be built entirely within the machine frame and be relied upon to deliver unvarying amounts of oil to every inaccessible and hidden bearing.

"Self-cleaning" adjustable feeders, constructed to prevent dirt stoppage, are supplied either with sight glasses for gravity feed through drip tubes or for pressure feed, without sight glasses. All bearings may be instantly flushed by indicator flush lever. Send for Bulletin B-10.

PULSOLATOR AUTOMATIC OIL LUBRICATION

RIVETT LATHE & GRINDER INC.
BRIGHTON, BOSTON, MASS.

Business and Sales Briefs

EVAN G. ANDERSON, for several years associated with Rivett Lathe & Grinder Inc., Brighton, Mass., has opened an office as sales representative for his company at 439 Penton building, Cleveland. Mr. Anderson will contact Ohio manufacturers, studying with them their requirements for automatic lubrication.

* * *

George E. Clifford has been appointed district sales manager for Republic Steel Corp. in the Los Angeles district succeeding George F. Emanuels, resigned.

* * *

Joseph M. Bandish is now director of sales of the metallic packing division of Felt Products Mfg. Co., 1504 Carroll avenue, Chicago.

* * *

E. A. Hancock is now district manager of the industrial department of the New England district of General Electric Co. Mr. Hancock succeeds C. A. Chase who retired Oct. 31.

* * *

Executive offices of Link-Belt Co., Chicago, have been moved to the Bell building, 307 North Michigan avenue, where they occupy the entire twenty-third floor and the north half of the twenty-first floor.

* * *

Dominion Engineering Works Ltd., Montreal, has been assigned Canadian manufacturing and distribution rights on Cone area-contact worm gearing, recently put on a production basis by Michigan Tool Co., Detroit.

* * *

Herschel V. Beasley has been added to the technical staff of the development and research department of International Nickel Co. Inc., 67 Wall street, New York. Mr. Beasley will make his headquarters in the New York office.

* * *

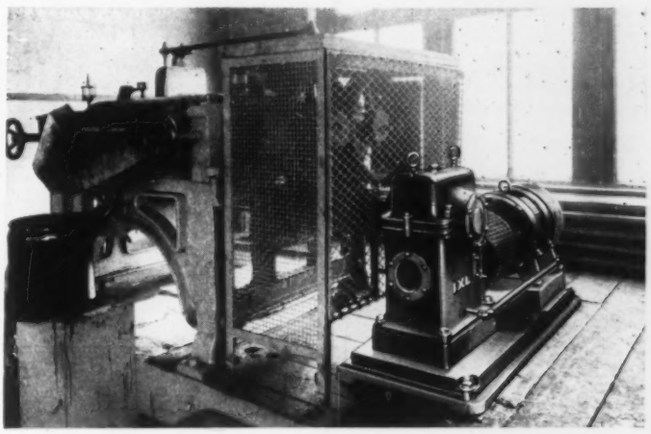
Gibb-Lewis Co., 231 South La Salle street, Chicago, has been formed for the purpose of dealing in patents and patented articles. W. H. Gibb, who has incorporated the new company, has resigned from his position as vice president of Thomson-Gibb Co. Mr. Gibb will continue on the board of directors of the latter company.

* * *

Robert J. Working has been appointed district sales manager for Republic Steel Corp. in the Birmingham, Ala., territory, succeeding Kenneth D. Mann who has resigned to become executive vice president of Truscon Steel Co. Paul R. Johnston has been named district sales

Another Way to Excel

—Use IXL Speed Reducers and Powered Gears



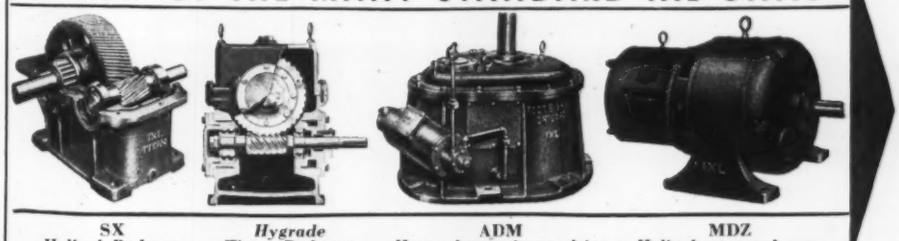
AFTER you have apparently exhausted the possibilities of improving your equipment, there is one more sales advantage for you to add—the adoption of an IXL drive. These units, backed by 75 years of manufacturing and designing experience, set the standard for efficiency and dependability. For example, IXLITE heat-treated gears are adapted to a much wider field than ordinary gears and wear approximately four times as long.

But from your standpoint it is even more important that users have become increasingly aware of the superiority of IXL products. To include IXL trademarked units and heat-treated gears in the design of your machine gives your sales organization one more big point to use in closing sales. Take advantage of our complete service in designing your drive.

Foote Bros. Gear & Machine Co.,
5303 So. Western Blvd., Chicago, Ill.

IXL
THE MARK OF QUALITY

A FEW OF THE MANY STANDARD IXL UNITS



SX	Hygrade	ADM	MDZ
Helical Reducer	*Worm Reducer*	*Heavy duty agitator drive*	*Helical powered gear*

IXL—5303 S. Western Ave., Chicago, Ill.

- ☐ Please have your representative call.
- ☐ Please send me literature on the items checked.
- ☐ Industrial Gears.
- ☐ Heat-treated Gears.
- ☐ Speed Reducers and Spur-Worm Helical.
- ☐ Powered Gears.
- ☐ Friction Clutches.
- ☐ Flexible Couplings.
- ☐ Special Machinery.
- ☐ Stoker Drives.

Name.....

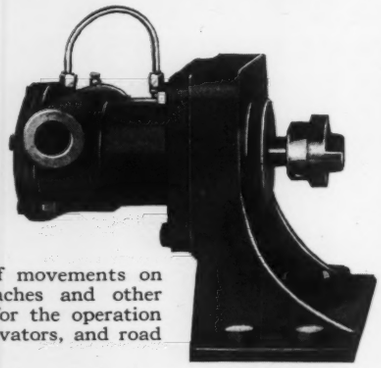
Company.....

Address.....

Viking Hydraulic

"Gear Within a Gear . . . Two Moving Parts"

Pressure Pumps



Designed and adapted for Oil Pressures up to 500 pounds per square inch intermittent service and 300 pounds continuous.

For the actuation of movements on multiple drills, broaches and other machine tools . . . for the operation of hydraulic lifts, elevators, and road machinery.

Because of its simple "Gear Within A Gear . . . Two Moving Parts" Principle . . . because of its sturdy construction . . . with over-size driving shaft and two extra large anti-friction bearings . . . the VIKING HYDRAULIC PRESSURE PUMP is rendering efficient and economical service on innumerable hydraulic applications. Made of laboratory-tested metals and offered in capacities of 5 to 45 G.P.M. Write for complete list of applications, specifications and prices.

VIKING PUMP COMPANY
CEDAR FALLS, IOWA

BEAUTY Plus Utility

Bakelite feet and handles add not only to the appearance but to the practical value of any electrical device. Molded handles have permanent lustrous finish which contrasts effectively with shining metal, and provides ideal insulation against heat and electricity.

The Hill-Shaw Company, manufacturers of the nationally known Vaculator, is another of the prominent Middle West firms who have chosen this organization to produce their molded parts. You are invited to submit details of your problem.

CHICAGO MOLDED PRODUCTS CORP.
2147 Walnut Street Chicago, Illinois

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*Advertisements appear in previous issues.

manager for Republic in the Cincinnati territory succeeding Mr. Working. Charles W. East, formerly of the Birmingham office of the company has been named assistant manager of sales in the pipe division, succeeding George E. Clifford, recently appointed district manager in the Los Angeles territory. In the Buffalo territory, C. C. Cherry has been appointed district sales manager.

* * *

The name of Thwing Instrument Co., Philadelphia, has been changed to Thwing-Albert Instrument Co. The new name involves no change in ownership, management, policy or product.

* * *

Michigan Tool Co., Detroit has let contracts for the erection of a new plant adjacent to its present factory on McNichols road to satisfy the need for additional production capacity ocasioned by improved business.

* * *

C. F. Burgess Laboratories Inc., Madison, Wis., has created the office of chairman of the board and C. F. Burgess has been elected to this office. Arba B. Marvin has been elected president.

* * *

Physicists Research Co., 337 South Main street, Ann Arbor, Mich., has been formed to aid in the solution of unusual industrial problems by the employment of applied technical research. E. J. Abbott, formerly research physicist, University of Michigan, is president.

* * *

Keith J. Evans has been appointed manager of the sales promotion division of Inland Steel Co., Chicago. Mr. Evans will continue to act in a similar capacity with Joseph T. Ryerson & Son Inc., in addition to his new duties.

* * *

The Peoria, Ill., office of Lincoln Electric Co., Cleveland, is now located at 923 South Washington street, and is under the direction of W. I. Miskoe, formerly of the Chicago sales office. Another new office has been opened by the company at Memphis, Tenn., in charge of O. B. Farrell. Lew Hinchman has been transferred to the Chicago district sales office of the Lincoln company located at 1455 West Thirty-seventh street. Other changes in personnel of the company include the addition of E. H. Weil to the San Francisco sales office and the transfer of Paul M. Corp to the Milwaukee sales office.

CROSS SECTIONS

DID YOU ever stop to consider the large number of engineering graduates who no longer follow their profession? Usually these men have a great deal of difficulty in getting started in other lines. We have frequently heard the opinion that executive ability is taken out of engineers through their training. What do you think?

ONE OF the major annoyances in buying a new automobile (or so they tell us) used to be the care necessary in the "breaking in" period. Now designers have evolved machines capable of manufacturing to such close tolerances that no breaking in is necessary. If some manufacturer will just get around to the next step, quoting delivered prices, and to giving a five-year financing plan at two per cent we might break down and get a new car!

SAVING of weight and retention of permanently fine appearance is possible with a new baked-on enamel. As the temperature required for baking the enamel is much lower than that formerly required, a thinner gage sheet can be used without danger of distortion.

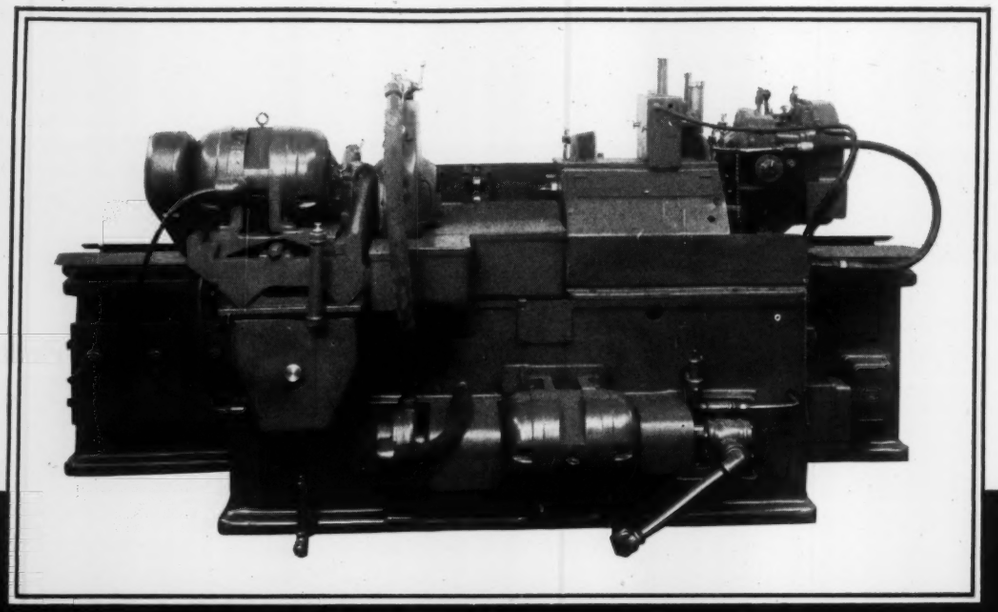
NEWS from Germany tells us of a robot farm hand which is one of the latest inventions at the Leipzig fair. This mechanism fills the cattle's manger at the right hours with the right quantity of fodder; when necessary, the fodder is moistened with the right quantity of water; and the whole business is entirely automatic. Now if the government will just install these machines on every farm and provide the fodder, AAA paternalism will be considerably advanced.

IT'S tragic to watch previously superlative manufacturers slowly passing into oblivion. We know of two or three who, overcapitalized, overproduced, under-brained and with surplus manufacturing facilities, are now on the way down—and out. A small investment in design and research brains—bringing new things to manufacture—would cure all that.

THE TIN industry is somewhat worried over the fact that bearing users are turning to other metals. Babbitt is one of the historic bearing metals that long dominated the field. However, the wider use of cadmium in the automotive field gives the tin interests considerable gratification. The continual fight of materials and parts makers to hold and increase markets never fails to benefit the designer, although you have to be on your toes to keep abreast of the developments.

FINISHING of aluminum and duralumin is simplified by a new primer which enables the designer to specify his decorative finishes without fear of inability to produce these finishes.

JUST a few short years ago designers of bottle filling, capping, labeling, washing and packaging machines had the entire beer industry for their market. Now a new group of designers are moving in, and coming fast, with machines for preparing, filling, sealing and packaging beer cans. Design must always be aggressive. The attack may come from any quarter. The designer who wins is the fellow that puts ideas into production before anyone else even dreams of them.



How good is its MOTOR?

Machines, like men, are no better than their motor systems

A first class fighter with a second rate heart can never hope to lead in his class. He's done before he starts.

A first class machine tool powered with a second rate motor has even less chance. Its lack of mechanical and electrical dependability will cost real money in service — causing lost time, lost profits and lost confidence in the manufacturer whose tool it powers.

Fairbanks-Morse motors power many of the best known machine tools because they have the heart and stamina to do a better job. Take an F-M Motor apart . . . special cuff-type insulation in the stator slots provides permanent insulation . . . each phase group coil is a single piece of wire with its lead connection welded eliminating a great many stub end connections . . . rotor and stator cores are held together without the use of bolts, nuts or rivets . . . in fact the only bolts and nuts in the entire motor are those few necessary to hold the bearings to the frame.

For information on Fairbanks - Morse motors for any industrial need, address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. 34 branches at your service throughout the United States.

Pioneer Designers and Manufacturers of POWER, PUMPING AND WEIGHING EQUIPMENT 105 Years

FAIRBANKS-MORSE
MOTORS

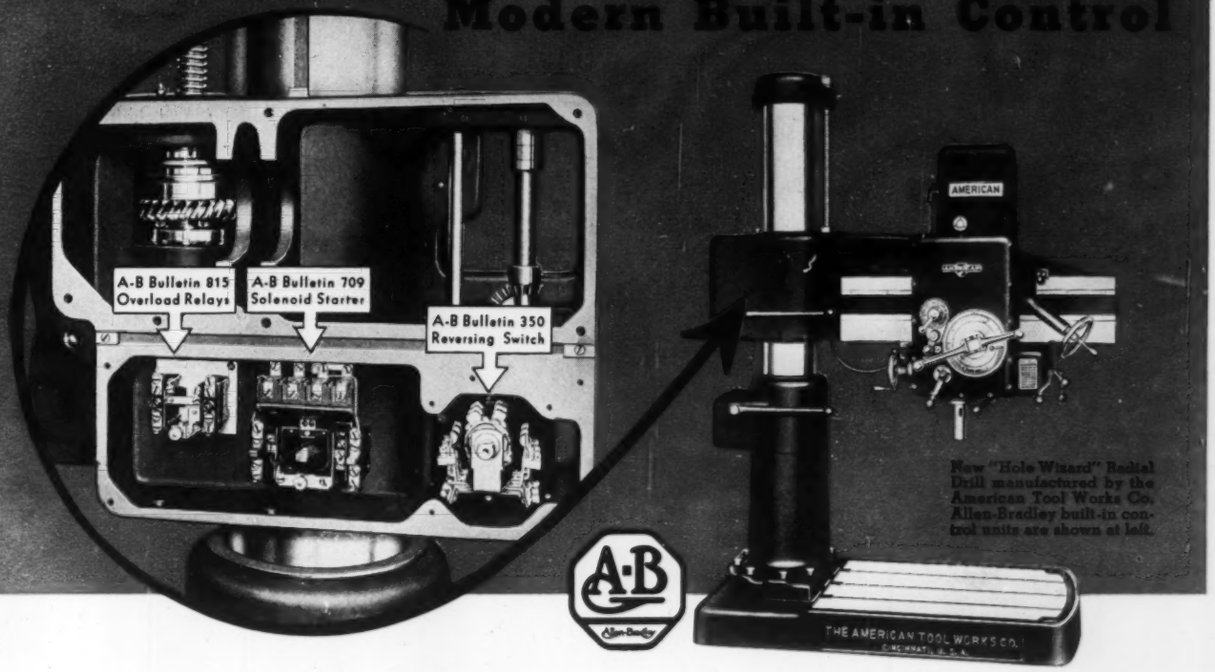
6523-EA40.93

ALLEN-BRADLEY SOLENOID STARTERS

are designed to meet these demands

of

Modern Built-in Control



New "Hole Wizard" Radial Drill manufactured by the American Tool Works Co. Allen-Bradley built-in control units are shown at left.

Allen-Bradley Solenoid Starters popular at 1935 Machine Tool Show!

WHY? Because Bulletin 709 solenoid starters were designed for built-in applications on motorized machines. Check the outstanding features which made these starters so popular at the recent Cleveland Machine Tool Show. You will find that they also cover your requirements.

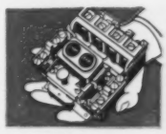
If you are modernizing your equipment—if you are incorporating the advantages of built-in control in your new machines—by all means investigate the Allen-Bradley 709 solenoid starters. In these modern starters you will find every advantage of performance, size, and appearance. Built in three sizes, these remarkable starters handle motor drives up to 30 H. P., 220 volts; 50 H. P., 440-550 volts. Just drop a request for the latest bulletin—write, today!

Allen-Bradley Co.
1333 S. First St., Milwaukee, Wisconsin

Allen-Bradley

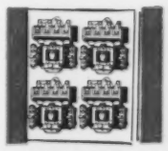
COMPACTNESS

The smallest starter on the market for its rating. Ideal for mounting several units side by side in small spaces available in the housings of machine tools.



EASE OF MOUNTING

Switch mechanism is mounted as a unit on a steel plate. Switches can be mounted on metal surfaces or machine frames without additional insulation.



CONFINED ARC

Molded hood completely encloses arc. There is no danger of flashover. Starters can be mounted closely in gangs allowing only Underwriters' clearances.

FRONT-OF-PANEL WIRING

—All wiring and electrical connections are clearly visible and accessible from the front of the starter. There is no back-of-panel wiring.

MAINTENANCE-FREE CONTACTS

—Double-break silver-alloy contacts never need to be filed or dressed. You can install the Bulletin 709 starter . . . and forget it.

A surface you can see to shave in » »

that's TIMKEN "MIRROR FINISH"

Unretouched Photograph of a typical ground cup and a Mirror Finish cup. Note how the mirror finish Timken cup on your right reflects the checkered background and compare it with the standard ground cup on your left.

"MIRROR FINISH", the amazing new finish developed by Timken for the contact surfaces of Timken Bearings, is all that the name implies. It is by all odds the finest finish ever applied to anti-friction bearings commercially.

For 37 years Timken has pioneered one bearing improvement after another to help users of Timken Bearings to improve the performance, accuracy, long life and economy of their Timken-equipped machines. Now this Timken spirit of pioneering has produced one of the greatest anti-friction bearing improvements of all time—Timken "MIRROR FINISH".

Timken "MIRROR FINISH" is the result of revolutionary advancements in grinding methods, materials, machines and surface measuring instruments. These advancements required years of research and experimentation, and involved hundreds of thousands of tests. Even when compared with the finish previously applied to Timken Bearings—which has always been noted for its fineness — the superiority of Timken "MIRROR FINISH" is instantly apparent.

Outstanding benefits to be expected from Timken "MIRROR FINISH" as applied to Timken Bearings are (1) smoother and quieter operation than has ever been known before. (2) inconceivably slight wear. (3) increased precision. (4) greater lubricating efficiency. (5) longer bearing life.

Timken "MIRROR FINISH" is not yet available in all sizes of Timken Bearings, but its advantages will be extended to our entire production as rapidly as the necessary new equipment can be built and installed.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *TAPERED ROLLER* BEARINGS

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